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Reaction Rate and Photochemical Data for Atmospheric Chemistry - 1977

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Reaction Rate and Photochemical Data for Atmospheric Chemistry - 1977 & Special Kulticulum No.

Edited by

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FOREWORD

The National Standard Reference Data System was established in 1963 for the purpose of promoting the critical evaluation and dissemination of numerical data of the physical sciences. The program is coordinated by the Office of Standard Reference Data of the National Bureau of Standards, but involves the efforts of many groups in universities, government laboratories, and private industry. The primary aim of the program is to provide compilations of critically evaluated numerical data. These tables are published in the Journal of Physical and Chemical Reference Data, The NSRDS-NBS Publication Series of the National Bureau of Standards, and through other appropriate channels.

The present report consists of tables of data assembled for use in modelling the chemistry of the stratosphere. It represents contributions from the Chemical Kinetics Information Center, other NSRDS data centers, and a number of individual experts. Support for the preparation of those tables has been provided by the Department of Transportation under the High Altitude Pollution Program, by the National Aeronautics and Space Administration under the Upper Atmosphere Research Program, and by the Office of Standard Reference Data, N.B.S. and the Office of Environmental Measurements, N.B.S.

David R. Lide, Jr. Chief, Office of Standard Reference Data

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R. F. Hampson, D. Garvin, Editors

A table of data for gas phase chemical reactions and photochemistry of neutral species is presented. Specifically, it gives preferred values for reaction rate constants, photoabsorption cross sections, and quantum yields of primary photochemical processes and also cites recent experimental work (to December 1977). It is intended to provide the basic physical chemical data needed as input data for calculations modelling atmospheric chemistry. An auxiliary table of thermochemical data for the pertinent chemical species is given in the appendix.

Key words: Air pollution; atmospheric chemistry; chemical kinetics; data evaluation; gas phase; photoabsorption cross section; photochemistry; quantum yield; rate constant.

1. Introduction

This technical note consists of a table of data on the kinetics of chemical reactions and the photochemistry of neutral species. It is designed for use in modelling the chemistry of the stratosphere and, to a more limited extent, the polluted troposphere and also the interpretation of laboratory experiments. The table of rate and photochemical data is supplemented by a table of thermochemical data for the species involved.

^{*}This work was supported by the High Altitude Pollution Program of the Federal Aviation Administration, U. S. Department of Transportation, by the Upper Atmospheric Research Program of the National Aeronautics and Space Administration, and by the Office of Standard Reference Data, N.B.S. and the Office of Environmental Measurements, N.B.S.

Earlier versions of this table have been issued as D. Garvin (editor) "Chemical Kinetics Data Survey IV" NBSIR 73-203 (1973); D. Garvin and R. F. Hampson (editors) "Chemical Kinetics Data Survey VII" NBSIR 74-430 (1974); and R. F. Hampson and D. Garvin (editors) "Chemical Kinetic and Photochemical Data for Modelling Atmospheric Chemistry" NBS Technical Note 866 (1975). The table appearing in NBS Technical Note 866 was also published in the U. S. Department of Transportation's Climatic Impact Assessment Program Monograph 1 "The Natural Stratosphere of 1974" E. Reiter, editor (1975). The present table supersedes all earlier versions.

Since the publication of NBS Technical Note 866 in 1975, a major effort in the evaluation of rate and photochemical data was undertaken for the NASA chlorofluoromethane assessment by its Laboratory Measurements Committee of which the present editors were members. The recommendations of this committee covering 104 chemical reactions and 48 photochemical processes are given in NASA Reference Publication 1010 "Chlorofluoromethanes and the Stratosphere" R. D. Hudson, editor, August 1977. These recommendations have been accepted by the editors of this table and are given here as preferred values. These recommendations are indicated either by the entry [†*NASA(1977)eval] or by the symbols [†*] immediately preceding the author's name in the reference column. The first notation is used to indicate that the committee has synthesized a preferred value from a consideration of all data sets. The latter designation is used when the committee has accepted the results of a particular study or of an existing evaluation.

Recommended values also are given for reactions not considered by the NASA Laboratory Measurements Committee. Some of these are drawn from other modern rate data evaluations, and the sources are indicated in the table. Other recommendations have been prepared for this work.

Rate data evaluation is a small but growing branch of physical chemistry. There are more recommended rate constants than contained in this table, but it does contain most of those which are applicable to atmospheric chemistry. Evaluations and compilations of rate data and on-going programs in these areas have been described in the recent review paper "Evaluation and Compilation of Reaction Rate Data" by R. F. Hampson and D. Garvin, Journal of Physical Chemistry 81, 2317-2319 (1977). A current extensive listing of sources of evaluated rate data, NBS List of Publications 73 "Chemical Kinetics Tables, Data Evaluations and Bibliographies. A Guide to the Literature" is available on request from the NBS Chemical Kinetics Information Center.

Three sets of detailed data sheets have been published by us in the course of preparing these tables. They are R. F. Hampson (editor) "Survey of Photochemical and Rate Data for Twenty-eight Reactions of Interest in Atmospheric Chemistry" J. Phys. Chem. Ref. Data 2, 267 (1973);

R. F. Hampson (editor) "Chemical Kinetics Data Survey VI, NBSIR 73-207 (1973); and D. Garvin (editor) "Chemical Kinetics Data Survey V" NBSIR 73-206 (1973), all recommendations contained in them (and still pertinent) are summarized in the present table.

We have also accepted many recommendations made by R. T. Watson in "Rate Constants for Reactions of ClO $_{\rm S}$ of Atmospheric Interest"

J. Phys. Chem. Ref. Data $\underline{6}$, 871 (1977) and by D. L. Baulch, et al "Evaluated Kinetic Data for High Temperature Reactions" Volume 1 (1972), Volume 2 (1973) and Volume 3 (1976), Butterworth and Co., London.

In addition to recommendations on rate and photochemical data the table includes listings of current research results. These data listings serve several purposes. Some simply record measurements, usually limited in number, on reactions for which it is not yet practical to give recommended values. Others show the data upon which a new recommendation is based. Still others show what has been done on a reaction since its rate constant was last evaluated. These new data may support the recommendation or suggest the need for modifications in the future.

2. Guide to the Table

2.1 General

This table provides current (December 1977) information on reaction rate constants, quantum yields and absorption cross sections. For many reactions, preferred values are given. The reactions included in the table are summarized in the index of reactions given in section 3.

Most of the important stratospheric reactions are in the tables. A number of the less important ones and some related systems are included, often simply for comparison.

The following remarks summarize the content of the table. It lists 416 reactions and gives a preferred value of the rate constant for 194 reactions; 136 based on recent reviews and 58 based on recent (1975-1977) experimental work. New data entries (1975-1977) are given for 252 reactions, showing substantial activity in the study of gas kinetics.

The following principles have been used in the selection and presentation of data:

- a. Where a preferred value is given for a rate constant or photochemical quantity, it is so indicated by an asterisk [*] placed ahead of the entry in the reference column.
- b. As indicated earlier an asterisk preceded by a dagger symbol [†*] is used to indicate those preferred values that have been recommended by the NASA Laboratory Measurements Committee and published in NASA Reference Publication 1010 "Chlorofluoromethanes and the Stratosphere" R. D. Hudson, editor, August 1977.

- c. Where there is a recent published evaluation of the data and there are no newer data, the evaluation is adopted and usually marked with an asterisk. The original data covered by the evaluation are not listed separately. However this latter rule has not been applied when the evaluation has appeared within the past year.
- d. Where there is an evaluation but there are new data, both are listed and a preferred value is indicated (marked by an asterisk).
- e. Where desirable, the available recent data sets are listed, and a selection is made or a preferred value is synthesized from them.

2.2 Uncertainty in Recommended Value of a Rate Constant

The uncertainty assigned here to the recommended value of a rate constant is given in the column "Notes and reliability of log k". This is an estimate by the evaluator of the absolute accuracy of the preferred value. It is a subjective judgment derived from intercomparison of data sets, consideration of related reactions studied with the same technique, estimates of how well the parameters could have been controlled, and comparison with theory. It means that in the evaluators judgment, the true value will lie within the indicated limits to a high level of confidence (90 to 95 percent).

Usually the uncertainty is indicated by the term \underline{D} in the expression: $\log_{10} k = C \pm D$. This is equivalent to the statement that k is uncertain to a factor of F where $D = \log_{10} F$. The statement that k has the value k_0 and is uncertain to a factor of F means that $k_0/F < k < k_0$ F.

Other forms used to indicate reliability are the following:

A < k < B means k lies in the range between A and B

k < (>) B means B is an upper (lower) limit

 $k\ \tilde{\ }$ B means B is only a rough guide to value of k

 $k = A \pm B$ alternative form for stating reliability limits

At times a rate constant expression is quoted from a paper with individual uncertainties for the rate parameters as $k = (A \pm a) \exp(-B \pm b/T)$. These measures are those provided by the author and often are indications of precision, not overall reliability.

Some notes are in order, regarding the statement of the uncertainty in the recommended value of the rate constant for those recommended values recommended by the NASA Laboratory Measurements Committee. Those recommendations were made for the limited temperature range 200-300 K. The uncertainty is indicated for T = 230 K, a typical midstratospheric temperature and in some cases allowance for extrapolation from higher temperatures was necessary. This is why occasionally the entry consists of the value of a rate constant measured at 298 K, the symbols [**] immediately ahead of the entry in the reference column to show that this value has been adopted by the Committee for the temperature range 200-300 K, and a statement of the uncertainty in the preferred value at T = 230 K. This stated uncertainty will generally be larger than the uncertainty in the measured value (measured at 298 K) to allow for the additional uncertainty introduced by extrapolation to T = 230 K.

For the recommendations made by the NASA Laboratory Committee the indicated uncertainties in NASA Reference Publication 1010 have been doubled in the present table in order to make the reliability statement analogous to a "95 percent confidence level".

2.3 Conventions Concerning Rate Constants

a. <u>General Convention</u>. Almost all of the reactions in the table are elementary processes. For them the rate expression is derivable from a statement of the reaction, e.g.

$$A + 2B \rightarrow AB_2$$

$$-d[A]/dt = -(1/2) d[B]/dt = d[AB2]/dt = k[A][B]2$$

Note that the stoichiometric coefficient for B, i.e. 2, appears in the denominator before B's rate of change (which is equal to $2k[A][B]^2$) and as a power on the right hand side.

Wherever there may be any doubt an explicit rate expression is given.

b. <u>Dissociation and Combination Reactions</u>. Some reactions of these types are not of integral kinetic order over the stratospheric pressure and temperature range. That is, although they require an energy transfer agent, "M," they are in the "pressure fall-off region". For some such reactions we tabulate rate constants that include the effect of the energy transfer agent and give rates for various altitudes. The reactions are written to demphasize "M," e.g.,

$$NO_2 + NO_3 (+M) \rightarrow N_2O_5 (+M)$$

$$^{\text{M}}_{3} \rightarrow \text{HO} + \text{NO}_{2}$$

The rate expressions to be used do not have the concentration of M in them, e.g., Rate = $k[NO_2]$ [NO₃] and $k[HNO_3]$ respectively. The units given for the k's, s-1 for first order, and cm⁺³ molecule-1_s-1 for second order, are consistent with this convention.

The altitude, temperature and number density regime used in these cases is

altitude/km	temp./K	log[M]/molecule cm ⁻³
15	217	18.60
20	217	18.27
25	222	17.93
30	227	17.58
35	237	17.26
40	251	16.92
45	265	16.60

This table follows the U. S. standard atmosphere, 1976.

c. <u>Forward and Reverse Reactions</u>. In some cases there are no data on a reaction of interest but there are data on the "reverse" reaction. Occasionally, for

$$A \rightarrow B$$
 (f)

$$B \rightarrow A (r)$$

an evaluation will use the data on the "reverse" reaction together with an equilibrium constant to obtain the other rate constant. Obviously this is an approximation but it often is a useful method of estimating non-measured physical properties.

The table contains notations to warn the reader when this procedure has been used, such as "based on reverse reaction," or when both reactions \underline{f} and \underline{r} are listed together " $k_f = k_r K_{eq}$ " or $k_r = k_f / K_{eq}$. These expressions, which are those used in the analyses, are based on equating the two rates at equilibrium.

$$R_{f} = R_{r}$$

$$k_{f}[A] = k_{r}[B]$$

$$K_{eq} = [B]/[A] = k_{f}/k_{r}.$$

2.4 Convention Concerning Optical Absorption Coefficients

These are reported in the table as "absorption cross sections per molecule, base e". They are defined by the equations.

$$I/I_o = \exp(-\sigma[N] \ell)$$

$$\sigma = (1/([N] \ell)) \ln (I_o/I)$$

where I_o and I are the intensities of incident and transmitted light, σ is the absorption cross section, cm²molecule-1, [N] is the concentration of absorbers, molecules cm⁻³, and ℓ is the path length, cm. Other definitions and units are frequently used. The terms "absorption coefficient" and "extinction coefficient" are common. It is always necessary to know what concentration units, path length units and type of logarithm (base e or base 10) are used in the definition. To convert "cross-sections" to absorption coefficients in (atm at 273 K)⁻¹ cm⁻¹, base e, multiply by 2.69 x 10^{19} .

A table of conversion factors is given in the appendix.

3. Arrangement of the Table

Data on a reaction appear only once in the table. The normal location for a reaction is determined by its reactants. Each species has been assigned a sequence number (1 to 65) as shown in the index that follows. These sequence numbers are the same as those used in NBS Technical Note 866. New species have been inserted in appropriate positions and assigned sequence numbers such as 34a, 34b, etc. A reaction is filed under the lower numbered species. That is, the reaction of ozone (7) with an oxygen atom (1) is filed under reactions of oxygen atoms. The numbers for the reactants appear at the left margin of the table, preceding the statement of the reaction, e.g. 1,7 $0+0_3 \rightarrow 0_2 + 0_2$. These number pairs run in ascending order through the table.

If a reaction is not filed in the location described above, a cross reference is given there. The most common exception is the listing together of data on the forward and reverse reactions of a pair, i.e. $A \rightarrow B$, $B \rightarrow A$.

In the index that follows, bimolecular reactions are listed under both reactants. Frequently the listing of reaction partners for a particular species is divided into two parts by three dashes, separating species earlier in the list than the species indexed from those later in the list. Reactions of the particular species with those species listed before the three dashes should be sought under those reaction partners. There is no indexing of products of reactions. A few species are listed in the index for which there are no reactions in the table, in anticipation of expansion of the data set.

REACTION INDEX

- 0, 0(1s), 02, 03, N, NO, NO2, NO3, N2, N2O, 1. 0 Rxn with: N₂O₅, NH₂, NH₃, H, HO, HO₂, H₂, H₂O, H₂O₂, HNO_{2} , HNO_{3} , SO , SO_{2} , SO_{3} , HS , $\mathrm{H}_{2}\mathrm{S}$, CS , CS_{2} , OCS, C10, BrO, OC10, HC1, HBr, NO3C1, C12, Cl₂O, CO, CO₂, CN, CHO, CH₂O, CH₃, CH₃NO₂, CH_3ONO , CH_4 , C_2H_4 , C_2H_6 , C_3H_6 , alkane, C₆H₆, C₆H₅CH₃, CH₃Cl
- 2. $O(^{1}D)$ Rxn with: 02, 03, NO, NO2, N2, N2O, NH3, H2, H2O, H₂O₂, HC1, CO₂, CH₄, C₂H₆, CF₂Cl₂, CFCl₃
- 3. $O(^{1}s)$ Rxn with: 0, O_{2} , O_{3} , NO, NO₂, N_{2} , $N_{2}O$, NH₃, H₂O, CO2, CH1
- Rxn with: 0, $O(^{1}D)$, $O(^{1}S)$ - -4. 02 hv, N, NO, NO₂, NO₃, N₂, H, H₂, H₂O, H₂O₂, HNO, SO, HS, Cl, CN, CHO, CH₃, CH₃O
- 5. $0_2(^1\Delta)$ Rxn with: O_2 , O_3 , N, NO, N_2 , H, SO, SO_2 , H_2S , CO, CF2Cl2, CCl4, CH3Cl, CH2Cl2, CHCl3
- 6. $0_2(^1\Sigma)$ Rxn with: O_2 , N_2 , H_2O
- 7. 0_3 Rxn with: 0, $0(^1D)$, $0(^1S)$, $0_2(^1\Delta)$ - hv, M, N, NO, NO, H, HO, HO, SO, SO, H₂S, Cl, Br, ClO, BrO, CO, CH₂O, CH₃, CH_3O_2 , CH_3ONO , CH_4 , C_2H_4 , C_3H_6 , allene, butenes, butadiene, C2Cl2H2

- 8. N Rxn with: $0, 0_2, 0_2(^1\Delta), 0_3 - -$ N, NO, NO₂, HO, SO, SO₃, OC10
- 9. No Rxn with: $0, 0(^{1}D), 0(^{1}S), 0_{2}, 0_{2}(^{1}\Delta), 0_{3}, N - hv, M, NO, NO_{2} + H_{2}O, NO_{3}, NH, NH_{2}, H, HO, HO_{2}, H_{2}, H_{2}O, H_{2}O_{2}, C1, C10, BrO, OC10, CH_{3}, CH_{3}O, CH_{3}O_{2}$
- 10. NO_2 Rxn with: 0, $O(^1D)$, $O(^1S)$, O_2 , O_3 , N, NO + H_2O - hv, M, NO_2 , NO_3 , NH_2 , NH_3 , H, HO, HO_2 , SO_2 , C1, C10, CH_3 , CH_3O_2
- 11. NO_3 Rxn with: 0, O_2 , NO_1 , NO_2 - hv, M, NO_3 , H_2O_1 , SO_2
- 12. N_2 Rxn with: 0, $O(^1D)$, $O(^1S)$, O_2 , $O_2(^1\Delta)$, $O_2(^1\Sigma)$ - M, HO
- 13. N_2O Rxn with: 0, $O(^1D)$, $O(^1S)$ - hv, M, H, H0, C10, C0
- 14. N_2O_5 Rxn with: O - hv, M, H_2O , SO_2
- 15. NH Rxn with: NO - -
- 16. NH_2 Rxn with: 0, NO - H, HO, H_2 , H_2O
- 17. NH_3 Rxn with: 0, $O(^1D)$, $O(^1S)$, $NO_2 - M$, H, H0, C10

17a. N₂H₄ Rxn with: H

- 18. H Rxn with: $0, 0_2, 0_2(^1\Delta), 0_3, \text{ No, NO}_2, \text{ N}_2\text{O}, \text{ NH}_2, \text{ NH}_3, \\ \text{N}_2\text{H}_4 - \\ \text{H, HO, HO}_2, \text{H}_2\text{O}, \text{H}_2\text{O}_2, \text{ HNO, HNO}_2, \text{ HNO}_3, \\ \text{SO}_2, \text{HS, H}_2\text{S, COS, OCIO, HCI, NOCI, Cl}_2, \text{CO,} \\ \text{CO}_2, \text{CH}_2\text{O}, \text{CH}_3\text{OOH, CH}_3\text{ONO, CH}_3\text{Cl}$
- 19. HO Rxn with: 0, 0₃, N, NO, NO₂, N₂, N₂O, NH₂, NH₃, H - M, HO, HO₂, H₂O, H₂O, H₂O₂, HNO, HNO₂, HNO₃, SO₂, H₂S, Cl, HCl, DCl, HBr, NO₃Cl, CO, CH₂O, CH₃OH, CH₃NO₂, CH₃ONO, CH₄, C₂H₂, C₂H₄, C₂H₆, C₃H₆, C₄H₁₀, alkane, C₆H₆, C₆H₅CH₃, CF₂Cl₂, CFCl₃, CCl₄, CH₃Cl, CH₂Cl₂, CHCl₃, CH₁Cl₁F_k

 - 21. H_2 Rxn with: 0, $O(^1D)$, O_2 , NO, NH_2 , HO, HO_2 - M, C1, C10
 - 22. H_2O Rxn with: 0, $O(^1D)$, $O(^1S)$, O_2 , $O_2(^1\Sigma)$, NO, NO₃, N_2O_5 , NH_2 , H, HO, HO_2 - SO_3
 - 23. H_2O_2 Rxn with: 0, $O(^1D)$, O_2 , NO, H, HO - hv, M, C1, Br

- 24. HNO Rxn with: O_2 , H, HO - M, HNO
- 25. HNO_2 Rxn with: 0, H, HO - hv
- 26. HNO_3 Rxn with: O, H, HO - hv, M, Cl
- 26a. S Rxn with: CS₂, COS
- 27. SO Rxn with: $0, 0_2, 0_2(^1\Delta), 0_3, N - S0, S0_3$
- 28. SO_2 Rxn with: 0, $O_2(^1\Delta)$, O_3 , NO_2 , NO_3 , N_2O_5 , H, HO, HO_2 - CH_3
- 29. SO_3 Rxn with: 0, N, H_2O , SO - -
- 30. S_2 0 Rxn with:
- 31. HS Rxn with: $0, 0_2, H - HS$
- 32. H_2S Rxn with: 0, $O_2(^1\Delta)$, O_3 , H, H0 - -
- 33. HSO₃ Rxn with:
- 34. H_2SO_4 Rxn with:
- 34a. CS Rxn with: 0 - -
- 34b. CS_2 Rxn with: 0, S - -
- 34c. COS Rxn with: O, H, S - -

Rxn with: 02, 03, NO, NO2, HO, HO2, H2, H2O2, 35. Cl $HNO_3 - - - C1$, OC10, C100, NOC1, NO_2C1 , NO₃C1, C1₂O, CH₄, C₂H₆ Rxn with: 0_3 , $H0_2$, $H_20_2 - - -$ Br Rxn with: $0, 0_3, N0, N0_2, N_20, NH_3, H0_2, H_2 - - -$ 36. ClO hv, ClO, BrO, CO, CH_{ll} , C_2H_2 , C_2H_{ll} 0, 0₃, N0, C10 - - - Br0 Rxn with: Br0 Rxn with: Cl - - hv, M 37. Cl00 OC10 Rxn with: 0, N, NO, H, Cl - - - hv 38. Clo_{3} Rxn with: 39. HCl Rxn with: 0, $O(^{1}D)$, H, H0 - - - hv Rxn with: 0, H0 - - -HBr 40. HOC1 Rxn with: hv 41. HOC10 Rxn with: 42. NOCl Rxn with: H, Cl - - - hv43. $NO_{2}Cl$ Rxn with: Cl - - - hv43a. NO_3Cl Rxn with: 0, H0, Cl - - hv44. Cl_2 Rxn with: 0, H - - - hv44a. Cl₂O Rxn with: O, Cl - - -

- 45. co Rxn with: 0, $0_2(^1\Delta)$, 0_3 , N_2 0, H, H0, H0, 0_2 , C10 - CH₃0
- 46. CO_2 Rxn with: 0, $O(^1D)$, $O(^1S)$, H - M
- 46a. CN Rxn with: $0, 0_2 - -$
- 47. CHO Rxn with: $0, 0_2 - -$
- 48. CH_2O Rxn with: 0, O_3 , H, H0, $HO_2 - hv$
- 49. CH_3 Rxn with: 0, 0₂, 0₃, No, No₂, So₂ - -
- 50. CH_3O Rxn with: O_2 , NO, NO₂, CO
- 51. CH_3O_2 Rxn with: O_3 , NO_2 , $HO_2 - CH_3O_2$
- 52. CH_3OH Rxn with: HO - -
- 53. CH_3OOH Rxn with: H - -
- 54. CH_3NO_2 Rxn with: O, HO - -
 - CH_3 ONO Rxn with: 0, 0₃, H, H0 - hv
- 55. CH_3NO_3 Rxn with:
- 56. CH_4 Rxn with: 0, $O(^1D)$, $O(^1S)$, O_3 , H0, C1, C10 - -
- 56a. C_2H_2 Rxn with: HO, ClO - -
- 57. C_2H_4 Rxn with: 0, O_3 , H0, H O_2 , C10 - -

58. $C_2^H_6$ Rxn with: 0, $O(^1D)$, H0, H0, C_2 , $C_1 - - -$

*59. $C_{3}^{H}_{6}$ Rxn with: 0, O_{3} , HO - - -

 $+60. C_3H_8$ Rxn with: 0, H0, H0, - - -

 $V60a. C_6H_6$ Rxn with: 0, H0 - - -

61. CF_2Cl_2 Rxn with: $O(^1D)$, $O_2(^1\Delta)$, HO - - - hv

62. $CFC1_3$ Rxn with: $O(^1D)$, HO - - - hv

63. $CC1_{4}$ Rxn with: HO - - - hv

64. CH_iCl_j Rxn with: 0, $O_2(^1\Delta)$, O_3 , H, H0 - - -

 $\sqrt{65}$. CH_iCl_iF_k Rxn with: HO - - -

√ and other halocarbons

^{*} and higher alkenes

t and higher alkanes

 $[\]nabla$ and other aromatics

296	empe	December 1977 Reaction/Reference	Temp.	Reaction Rate Constant	
d - d - M - M - M - M - M - M - M - M -	:		Range/K		
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Taylor (1975) review 2000-1000 1.7 x 10-28 T-17 x w = 9 Paulch, et al (1976) review 2000-1000 1.7 x 10-28 T-17 x w = 9 C		900000000000000000000000000000000000000	196	T-1	\$0°0\$
Equitor, et al (1976) review 190-200 1-37 2 x 10-36 rep(00/T)		Taylor (1975) review	2000-10000	x 10=32 T=1/2 M = N,) •
Baulch, et al (1976) review 190-4000 6.23 x 10 ⁻²⁵ exp(900/T) W " Ar a0.1 at act of 50 to 40 to 50.2 x 10 ⁻³⁵ exp(900/T) W " Ar a0.1 at act of 62 to 40 to 70 to 40 to				x 10-28 T-3/2 M = 6/2 x 10-28 T-3/2 M = 6	
d(\$7\) + \(\therefore\) + \(\there\) + \(\there		_	190-4000	x 10 0 T */ M = N, N4 x 10 3 exp(900/T) M = 6(1S) + G +	
Seview Second Ref. Refs. Ar(1.0)	>	¥			
review 300		*This Survey	200-346	= 6.6 x 10 ⁻³⁵ exp(510/T)	#207 H20(15)
Fr. 1.65 x 10 ⁻³⁵ exp(1050) Fr. 1.65 x 10 ⁻³⁵ exp(1050) 1972) 200-346 Fr. 6.6 x 10 ⁻³⁵ exp(510) Rel. W efficiencies: Ar(1) 800 Kg = 4.7 x 10 ⁻³⁵ exp(840) 800 Kg = 1.0 x 10 ⁻³⁵ exp(840) 800 Kg = 1.0 x 10 ⁻³⁵ exp(100) 800 Kg = 1.0 x 10 ⁻³⁵ exp(100) 800 Kg = 1.0 x 10 ⁻³⁵ exp(100) 800 Kg = 5.0 x 10 ⁻³⁵ exp(100) 800 Kg = 5.0 x 10 ⁻³⁵ exp(100) 800 Kg = 5.0 x 10 ⁻³⁵ exp(1050) 800 Kg = 4.4 x 10 ⁻³⁴ 800 Kg = 4.4 x 10 ⁻³⁴ 81 295 Kg = 2.29 x 10 ⁻³⁴ 81 295 Kg = 5.4 x 1.2 x 10 ⁻³⁴ 81 81 82.8 x 10 ⁻³⁴ 83.00 84.00 84.00 84.00 84.00 84.00 84.00 84.00 84.00 84.00 86.			300	= 5.5×10^{-34} M = N_2 = 4.1×10^{-10} exp(=11430/T) M = Ar	
Rel. M eff.: 63(1.0), Ar		Johnston (1968) eval.	200-1000	- 4.6 x 10-35 exp(1050/T)	*0.1
Davis (1972) Davis (1972) Davis (1968) 213-386 Ref., W efficiencies: Ar(1,0) (1968) 300 Ref., W efficiencies: Ar(1,0) Ref., W eff: Ar(1,0) Ref.,				= 1.65 x 10 9 exp(=11400/T)cm molecule=1 • M eff.: 6 ₃ (1.0), Ar(0.25), 6 ₂ (0.44),	0.30)
Amms (1968) 213-386 214 4.7 × 10 35 exp(840) (1968) 300 215 300 217 10 218 100 × 10 34 cm6molec 21971) 21971] 21971) 21971) 21971) 21971) 21971) 21971) 21971) 21971]		_	200-346	= $6.6 \times 10^{-35} \exp(510/T)$	•
(1968) 300		Mulcahy, Williams (1968)	213-386		٣,٥١٠١)
971) 971) 971) 800 81 82 82 82 8300 82 84 84 84 84 84 84 84 84 84		Meaburn, et al (1968)	300		
n, Kirsch (1970) 300		Stunl, Niki (1971)	300	5.4 x 10=34 cm6molecule=2s=1 M efficiencies: N=(1,0) = (1,18), C=(1,24)	
(1971) $\frac{Ar(1.0)}{300}$ $\frac{K_f}{k_f} = \frac{8 \times 10^{-34}}{4.4 \times 10^{-34}}$ $\frac{M}{M}$ (1970) $\frac{300}{300}$ $\frac{K_f}{k_f} = \frac{4.4 \times 10^{-34}}{1.24 \times 10^{-34}}$ $\frac{1.24 \times 10^{-34}}{1.24 \times 10^{-34}}$		Donovan, Husain, Kirsch (1970)	300	= 5.0 x 10 34 cm molecule 2s M = M =	
(1971) (1970) (1970) (1970) (1970) (1971) (1973)				Ar(1.0), Kr(0.98),	
n (1973) 295 R _f = 5.28 x 10 ⁻³⁴ N _f = 5.4 ± 1.2 x 10 ⁻³⁴ Rel, efficiencies: N ₂ (1, pert, Troe (1975) 300 K _f ~ 8 x 10 ⁻³⁴ cm ⁶ molecul		Hippler, Troe (1971)	000 6	8 x 10 0 34 x	2
300		Francis (1969)	300	= 1.24 x 10=34	N
73) 295		Sauer (1967)	300	= 2.28 x 10=34 M	
Troe (1975) 300 k _f ~ 8 x 10 ⁻³⁴ cm ⁶ molecule ⁻² s ⁻¹ M = N ₂ k _x , = 2.8 x 10 ⁻¹² cm ³ molecule ⁻¹ s ⁻¹		Ball and Larkin (1973)	295		8)
		_	300	k _f ~ 8 x 10 ⁻³⁴ cm ⁶ molecule ⁻² s ⁻¹ M = N ₂ k _s . = 2.8 x 10 ⁻¹² cm ³ molecule ⁻¹ s ⁻¹	

December 1977	1977			
		Temp.	Reaction Rate Constant No	Notes and
No.	* * Preferred Value + * NASA (1977) eval	Range/K		Reliability of log k
1. 4 k	Hogan, Burch (1976) 6 + 6, + M + 6, * + M	0 0 m	(a) Reevaluation of work in Hippler, Troe (1971) (b) 2d order high pressure limit 6.3 x 10 34 M = 82	
	Bevan, Johnson (1973)	0 0 m r	5.4 x 10 ⁻³⁴ cm ⁶ molecule ⁻² s ⁻¹ M = 0 ₂ Rel. efficiencies: 0 ₂ (1.0), Ar(0.50), N ₂ 0(2.4), C0 ₂ (2.5), SF ₆ (5.7) 3 x 10 ⁻³⁴ cm ⁶ cmlecule ⁻² s ⁻¹	(a)
1,57			•	
> 0	*Hampson (1973) eval. Baulch, et al (1976) review McCrumb, Kaufman (1972) Lundell, Ketcheson, Schiff (1969) Husain, Kirsch, Donovan (1972) Bavis, Wong, Lephardt (1973)	220-1000 200-500 269-409 300 300 220-353	1.9 x 10 ⁻¹¹ exp (-2300/T) 8.6 x 10 ⁻¹² exp(-2090/T) 1.1 x 10 ⁻¹¹ exp (-2155/T) 1.5 x 10 ⁻¹⁴ 1.3 x 10 ⁻¹⁴ 2.0 x 10 ⁻¹¹ exp (-2280/T)	# 0 • 1
	*Baulch, et al (1973) review Taylor (1975) Campbell, Gray (1973)	200 - 400 2000 - 10000 298 196	1.8 x 10 ⁻³¹ (T) ^{-0.5} cm ⁶ molecule ⁻² s ⁻¹ , M = N ₂ 2.8 x 10 ⁻²⁸ I ⁻³ / ² M = N ₂ , G ₂ , N ₂ G 5.5 x 10 ⁻²⁷ I ⁻³ / ² M = NG 9.2 x 10 ⁻³³ 12.1 x 10 ⁻³³	0 4
	6 + NØ - N + Ø ₂ (f) Ø ₂ + N - NØ + Ø (r) *Baulch, et al (1973) review +*Becker, Groth, Kley (1969) Baulch, et al (1973) review	1000-3000 280-333 300-3000	15T exp(-19500/T) 212 exp(-3200/T) 14T exp(-3150/T)	*0.12 at 1000K (a)
1,9 1,9M 10,M	Taylor (1975) 0 * NØ + NØ * hv Becker, et al (1973) 0 * NØ * M + NØ * M (f) NØ * M + NØ * Ø * M (r)	300	k _r = 2.2 x 10 ⁻¹⁴ (T) exp(-3560/T) 4.2 x 10 ⁻¹⁸	
	+*Whytock, Michael, Payne (1976) Baulch, et al (1973) review	220-500	k _f = 1.55 x 10 ⁻³² exp(584/T)cm ⁶ molecule ⁻² s ⁻¹ , W = N ₂ k _f = 3.0 x 10 ⁻³³ exp(940/T)cm ⁵ molecule ⁻² s ⁻¹ , W = θ ₂ Rel. W efficiencies: θ ₂ (1.0), Ar(1.0), N ₂ (1.4)	N + 60.2
		1400-2400	kr = 1.8 x 10 8 exp(-33000/T)cm3molecule-1s-1	*0.1

December 1977	r 1977 Reaction/Reference * = Preferred Value + = NASA (1977) eval	Temp. Range/K	Reaction Rate Constant k/cm ³ molecule ¹ s ⁻¹	Notes and Reliability of log k
	Stanger, Wood, Black (1973)	296	M = Ar K _f = 6.0 x 10=32 M = Ar	
		241	= 13.0 x 10=32	
	Hippler, Schippert, Troe (1975)	300	= 7.4 \times 10 ⁻³² cm ⁶ molecule ⁻² s ⁻¹	
			.) " 3.0 x 10"11 cm3molecule"1s"1 2d order high pressure limit	(a)
	Atkinson, Pitts (1574)	300-392	- 2.6 x 10 = exp(450 + 100/T	
	Singleton, et al (1975)	298-473	= 1.7 x 10 3c exp(620/T), M =	
	Campbell, Handy (1976)	285-425	$k_{\rm f} = 5.0 \times 10^{-33} {\rm exp(900/T)}, {\rm M} = {\rm N_2}$	
	Michael, Payne, Whytock (1976)	217-500	$k_f = 1.08 \times 10^{-32} \text{exp(520/T)}, M = \text{He}$	
			- 9.33	
			Kg = 9.01 x 10 = 3 exp(590/T), M = Ar	
1,9M	6 + N6 + M + N6, + M + hv		e */ I/O COMPa Of V	
	Becker, et al (1973)	300	7 x 10"32 cm6molecule"?s"1	
1,10	$\theta(^3P) + N\theta_2 + N\theta + \theta_2 (f)$ $\theta_1 + N\theta_1 + N\theta_2 + \theta$ (r)			
	+*Davis, Herron, Hule (1973)	230=339	kφ = 9.1 x 10=12	*0.06
	Baulch, et al (1973)	300-550	- 1.7 x 10 ⁻¹¹	
				±0.1
	Clyne, Cruse (1971)	300	* 8.3 ×	
	Harker, Johnston (1973)	300	kf = 9.2 x 10=12	(a)
	Clyne, Cruse (1972)	298	kf = 6.1 x 10°12	
	Slanger, et al (1973)	300	kf = 9.3 x 10=12	(a)
		240		
	Hampson, et al (1973a) review	220-500	Kg = 9.1 x 10=32	±0°08
	Stunl, Niki (1970)	300		(p)
	Bemand, Clyne, Watson (1973)	230-1055		(°)
		258	kg = 9.5 ±1.1 x 10=12	
			(a) k/k(0 + N0 + M) measured, where k(ref) = 6.9 x 10=32 (b) Similar techniques were used by Slanger and by Stuhl and Niki: Flash photolysis - chemiluminescence.	6.9 x 10=32 and by Stuhl
				other recent
1,10M 11, M	$\theta + N\theta_2 + M + N\theta_3 + M (f)$ $N\theta_3 + M + N\theta_2 + \theta + M (f)$			
	*Hampson, et al (1973a) review	298	kf = 1.0 x 10 = 31 cm 6 molecule = 2 s = 1 M = N2	₹0.2
	Baulch, et al (1973) review	295	= 6.3 x 10=32 M = N2	40.4
			The second secon	

	December 1977	9 1	Temp. Range/K	Reaction Rate Constant k/cm3molecule 1s-1	Notes and Reliability of
Kr		+ = NASA (1977) eval			log k
300 (1.0 ± 0.4) x 10-11 xriv	Hippler	Hippler, Schippert, Troe (1975)	300	.8 x 10"42 cm3molecule"1s"1, M = 8.0 x 10"32 cm ⁶ molecule"2s"1 M)	a a
view 1300=2500	Graham, Johns Graham, Johns G + N ₂ + N + G + N ₂ + M + N ₂ C + M + N ₂	(87	00 E	(1.0 ± 0.4) x 10-11 see reverse reaction	
view 1200=568 (a) kg = krkeq (b) 2d order high pressure limit (c) 1st order high pressure limit (d) 1st order limit (e) 2d order high pressure limit (e) 2d order	Baulch	Baulch, et al (1973) review	1300-2500	3.9 x 10 35 4 Ar Ar 8.3 x 10 10 M Ar 5.5 x 10 15	
view 1200=2000 k ₁ = 1.7 x 10 ⁻¹⁰ exp(=14.1 x 10 ³ /T)	Schoff	Schofield (1973) review	300=568	1.3 x 10*11 exp(=30000/T)s"1 kf	٥ د
2000=10000	NG • NN • NG • NG • NG • NG • NG • NG •	6 + N ₂ 6 - N ₂ + 6 ₂ (1) 6 + N ₂ 6 - N6 + N6 (2) N6 + N6 - N ₂ 6 + 6 (2r) Baulch, et al (1973) review	1200-2000	1.7 x 10 ⁻¹⁰ 1.7 x 10 ⁻¹⁰ - 2.2 x 10 ⁻¹² Based on k ₁ /k	\$0.4 (a) \$0.3 \$0.7 (h)
300 3.5 x 10 ⁻¹² (k _a + k _b) 361-677 k _f = 6.6 x 10 ⁻¹² exp(-3300/T) 300-1000 k _f = 2.5 x 10 ⁻¹² exp(-3020/T) 300-1000 k _f = k _f /K _{eq} = 1 x 10 ⁻¹³	Taylor 6 + N ₂ Grahan	(1975) review (95 - products 1. Johnston (1978)	300		
361-677 k _f = 6.6 x 10 ⁻¹² exp(-3300/T) ±0.3 300-1000 k _f = 2.5 x 10 ⁻¹² exp(-3020/T) ±0.2 300-1000 k _f = k _f /K _{eq} = 1 x 10 ⁻¹³ ±0.2	Gehrin Gehrin	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 0 m	.5 x 10 12 (kg	
	*Kuryl Baulch	o, et al (1969) , et al (1973) review	361=677 300=1000 300=1000	6.6 x 10 12 2.5 x 10 12 kr/Keq = 1 x	

December 1977		E		
	keaction/kererence * = Preferred Value	Range/K	k/cm_molecule_1s_1	Reliability of
No.	+ = NASA (1977) eval			
	Albers, et al (1965)	300-1000	k _f = 2 x 10 ⁻¹² exp(-3000/T)	
	Kondratiev (1970) review	350-1000	<pre>k_f = 1.8 x 10⁻¹² exp(-2500/T) Data of Albers, et al provide an upper limit when extrapolated to 220K (a) H6 * NH * NH * H.6 may be preferred channel.</pre>	ne!
1,18M	N + 9H + M + H + 9		2 6	
	Schoffeld (1973) review Baulch, et al (1972) review	1000-3000	~2 x 10 32 cm molecule 8 N = Ar No recommendation	#1 estimate
1,19	$\theta + H\theta + H + \theta_2 (f)$ $\theta_2 + H + \theta + H\theta (r)$			
	+*Wilson (1972) review	300-2000	kg = 4.2 ± 1.7 x 10"11	ಕ0. ಟ.04
	*Baulch, et al (1972) review	700-2500	7.6	100
1,19K	ch, et al (1972) : $H\theta + M \rightarrow H\theta_2 + M$	300	Kg = 3.8 ± 1.7 × 10 ⁻¹³	40.17
20,M	H6 ₂ + M + 6 + H6 + M (r) Baulch, et al (1972) review 6 + H6, + H6 + 6,		no recommendation for forward or reverse rxn	
	2		1	10000 40 600
	TEDUTIONE, BAILISE, INTUSH (1477)	n N	ог к(д + нд)	18 V 10 C 10
1,21	Lloyd (1974) review $\theta + H_2 \rightarrow H\theta + H (f)$	~300	8 x 10 ⁻¹¹ exp(=500/T)	estimate
18,19	H + H6 + 6 + H2 (r)			
	Baulch, et al (1972) review	400=2000	$k_{\underline{f}} = 3.0 \times 10^{-14} (T) \exp(-4480/T)$ $k_{\underline{f}} = k_{\underline{f}}/K_{\underline{G}} = 1.4 \times 10^{-14} (T) \exp(-3500/T)$	*0° 13
	Dublnsky, McKenney (1975)	347=742	k = 8.8 x 10-12 exp(-4200/T)	
	Schott, et al (1974)	1400-1900	$k_{\rm f}/k_{\rm ref}$ = 3.6 ± 0.7 Ref rxn ls θ_2 + H \rightarrow θ + H θ	
	Campbell, Handy (1975)	363-490	$k_p = 5.1 \times 10^{-11} \exp(-4950/T)$	
1,22	6 + H ₂ 6 + H6 + H6 6 + H ₂ 6 + H + H6		see reverse reaction	
1,23	Baulch, et al (1972) review $\theta(^{3}P) + H_{2}\theta_{2} = H_{2}\theta + \theta_{3}$ (b)		no recommendation	
	01	283-373	K(a.b) = 2.75 x 10 ⁻¹² exp(-2125/T)	#0.3 (a)
		370-800	$K(a + b) = 4.6 \times 10^{-11} \text{ exp(-3220/T)}$	+ 00m 0m
			of the transfer of the transfe	6 ₂ requires
1,25	6 + HN6, - H6 + N6,		a compress realitating characters	
	This survey		No data, Probably faster than 6 * HN63, since it	e it
			is 94 kJ/mol more exothermic.	The second secon

December 1977	1977			
	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and
	* * Preferred Value	Range/K	k/cm ³ molecule ¹ s ⁻¹	Reliability of
No.	+ * NASA (1977) eval			н м
	Hollinden, Kurylo, Timmons (1970)	205-300	2.9 x 10 ⁻¹³ exp(-750/T)	(a)
	Baulch, et al (1976) review		no recommendation	
	Schofield (1973) review	200-350	6.3 x 10-13 exp(-920/T)	F .04
ŗ			(a) Assumes stoichiometry of 3.5	
8 + C * 1		G G	111	
	"bauten, et at (1970) review	200	2.2 X 10	N. • C. H
	Bida, et al (1976)	300	2.24 × 10-1.	
	Slagle, et al (1975)	305	2.06 x 10 ⁻¹¹	
1,34b	6 + CS2 + CS + S6 (a)			
	+ 9CS + S (P)			
	*Baulch, et al (1976) review	200-1000	$k_{\rm a} = 3.7 \times 10^{-11} \exp(-700/T)$	±0.15, T<360K
	Wel, Timmons (1975)	218-293	2.8 ×	
	Slagle, et al (1974)	302		
			.0 .	
	Graham, Gutman (1976)	249-500	k,/k decreases from 0.098 at 249K to	
			0.081 at 500K	
1,34c	6 + 8CS + S6 + C6			
	Manning, et al (1976)	296	1.10 ± 0.1 x 10 14 P = 50 Torr	
	Wei. Timmons (1975)	239-404		
	Klemm S+ief (1974)	263-502	1.65 x 10-11 exp(=2165/T)	
	Banloh of al (1976) review	190=1200	0.6 × 10=11 exp(=0000/T)	#0.0 T < 600K
				· (-
1,36	6 + cl6 - cl + 62			
	+*NASA (1977) eval	200-300	7.7 x 10-11 exp(=130/F)	*0.12
	(1076) Nin (1076)	220-426	10-10	
	court at the court	2014	(a) Selected by Watson (1977) review	(B)
	Zahniser, Kaufman (1977)	218-295		(2)
	;	3	(b) k _{ref} * k(cl + d ₂)	
1,36Br	6 + Br6 - Br + 62			
	+*NASA (1977) eval	200-300	3 x 10 11	±0.8 at 230K
1,37	6 + 6c16 - c16 + 62			
	+*NASA (1977) eval	200-300	2 x 10-11 exp(-1100/T)	±0.6 at 230K (a)
	Bemand, et al (1973)	298		\$ 0 *
		3	Based on room temp value of Benand.	e t
39	6 + HCl - H6 + Cl (f)			
9.35	<i>,</i>			
	, P	200-300	$k_a = 1.14 \times 10^{-11} \exp(-3370/T)$	±0.3 at 230K
	44N4 C4 (1077) Cm2)	000		# C + + + + + + + + + + + + + + + + + +
	TOTAL (151) UCUN.		ba v I	5
	Balakhnin, et al (1971)	295=371	$k_f = 1.74 \pm 0.6 \times 10^{-12} \exp(-2250/T)$	
	Brown, Smith (1974)	293-440	$k_f = 2.5 \times 10^{-12} \exp(-2970 \pm 150/T)$	
	Wong, Belles (1972)	356-628	$k_{\phi} = 1.9 \pm 0.3 \times 10^{-11} \exp (-3580/T)$	
1,39	6 + HCl(v = 1) - H6 + Cl (a)		4	
	- 8 + HCl(v = 0) (b)			

December 1977				
	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and
2	* = Preferred Value	Range/K	k/cm~molecule 's'	
No.				10g k
	Arnold1, Wolfrum (1974)	300	3.6 ± 1.2 x 10 12	(a)
	Brown, Glass, Smith (1975)	196-400	6.2 x 10-12 exp(-500/T)	(a)
			(a) Total rate constant for sum	
1 2CBs	4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 +		of two reaction paths.	
196C .	+*NASA (1977) eval	200-300	7.6 x 10=12 exp(=1570/T)	#0.8 at 230K
	Brown, Smith (1975)	267-430	$4.0 \times 10^{-12} \exp(-1360 \pm 50/T)$	
	Takacs, Glass (1973)	298	$(4.4 \pm 1.0) \times 10^{-14}$	
1,43a	6 * N63Cl - products			
	+*NASA (1977) eval	200-300	3.0 x 10-12 exp(-808/T)	±0.15 (a)
	Molina, et al (1977)	213-295	2.4 x 10-12 exp(-840/T)	
	Kurylo (1977)	225-273	$1.9 \times 10^{-1}^{2} \exp(-692/T)$	
	Ravishankara, et al (1977)	245	2 x 10 13	
;	7		and that of Molina, et al (1977)	
1,44	9 • c12 • c19 • c1			
	*Clyne, et al (1976)	174-602	4.2 x 10-12 exp(-1370/T)	(a)
			ndation based on	299=502K)
			and other recent work. Also recommended by Wateon (1977) newlew.	inded by
1,448	6 + Cl ₂ 6 + 2Cl6			
		000	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	•
1,45M	CG + M - CG2 + M)	7 • • • • • • • • • • • • • • • • • • •
46M	C62 + M + 6 + C6 + M (r)			
	*Baulch, et al (1976) review	250-500	$k_f = 6.5 \times 10^{-33} \exp(-2180/)$ M = C6	
			in the second se	inc. to #0.5 at 500K
		296	$k_{\perp} = 2.3 \times 10^{-30} M = N_2$ no recommendation for k_{\perp}	
1,46 4,45	$\theta + c\theta_2 - c\theta + \theta_2$ (f) $\theta_2 + c\theta - \theta + c\theta_2$ (r)			
	*Baulch, et al (1976) review	1500-3000	$k_f = 2.8 \times 10^{-11} \exp(-26500/T)$	\$0,3 (α)
		1500-3000	$k_{\rm r} = 4.2 \times 10^{-12} {\rm exp(=24000/T)}$	E .0 ♣
·			(a) kf " kr Keq	
1,408	Shart it as well amm (1976)	800		
	Albers, et al (1975)	275-387	0,0 × 10 11	
1,47	6 + CH6 - C62 + H (a)			
	- C6 • H6 (b)			
84.1	*Washida, et al (1974)	297	$2.1 *0.4 \times 10^{-10} (k_a + k_b)$	
	N	1		
	Terron, Hule (1973) review	300	2 x 10 = exp(=1450/1) 1.5 x 10 = 13	#0.4 at 230K (a)

Nack, Though (1973)	December 197	Reaction/Reference	Temp.	Reaction Rate Constant	poe setoN
### ### ##############################			Range/K	k/cm_molecule_1s_1 Re	iability of
### ### ### ### ### ### ### ### ### ##	No.	- NASA			
### ### ##############################		Mack. Thrush (1973)	000	n, r 10 14	40.05
### ### ### ### ### ### ### ### ### ##))	"A factor"	•
Washida, Bayes (1977) 259-341 k, -1.0 ± 0.2 x 10-10 Washida, Payes (1977) 300 k, negligible kyla, -0.05 Sizele, Pruse, Gutman (1972) 300 k, negligible kyla, -0.05 Peeters, Mahnen (1973) 300 k, deriver exempthylethylane) = 1.5 Peeters, Mahnen (1973) 300 k, deriver exempthylethylane) = 1.5 Peeters, Mahnen (1973) 300 k, deriver exempthylethylane) = 1.5 Bowman (1975) 300 k, deriver exempthylethylane) = 1.5 Bowman (1975) 300-322 4 - 1.7 x 10-10 Pruse, Single, Outwan (1974) 300-410 2.3 x 10-11 Pruse, Single, Outwan (1974) 300-400 5.5 x 10-12 Singleton, Putte (1973) eveluation 300-500 5.6 x 10-12 Singleton, Putte (1973) evaluation 300-500 4.1 x 10-12 Singleton, Putte (1973) evaluation 300-500 4.1 x 10-12 Singleton, Putte (1973) evaluation 300-500 4.1 x 10-12 Singleton, Putte (1974) 300-392 5.6 x 10-12 Singleton, Putte (1974) 300-392 3.6 x 10-12 Singleton, Coetanovic (1976) 300-392 3.6 x 10-12 Singleton, Putte (1974) 300-392 3.6 x 10-12 Singleton, Putte (1974) 300-392 3.6 x 10-12 Singleton, Putte (1975) 300-392 3.0 expectedory, and tertlary hydrogen Singleton, Putte (1975) 300-392 3.0 expectedory, and tertlary hydrogen Singleton, Putte (1975) 300-392 3.0 expectedory, and tertlary hydrogen Singleton, Putte (1975) 300-392 3.0 expectedory, and tertlary hydrogen Singleton, Putte (1975) 300-392 3.0 expectedory, and tertlary hydrogen Singleton, Putte (1975) 300-392 3.0 expectedory, and tertlary hydrogen Singleton, Putt	64.	+ CH ₃ + CH ₂ 6 + H (
Stable Fruss. Gutman (1973) 300 km Fruss. Gutman (1974) 300 km Fruss. Gutman (1975) 300 km Fruss. Gutman (1975) 300 4		Washida, Bayes (1976)	259=341	$k_{-} = 1.0 \pm 0.2 \times 10^{-10}$	
Single Proteins (1974) 300 kg = 1.55 to .28 x 10 ⁻¹⁰ Proteins (1974) 300 kg = 2.2 x 10 ⁻¹⁰ expt-100/T) Proteins (1975) 1100-1900 kg = 2.2 x 10 ⁻¹⁰ expt-100/T) 1100-1900 kg = 2.2 x 10 ⁻¹⁰ expt-100/T) Proteins (1975) 1100-1900 kg = 2.2 x 10 ⁻¹⁰ expt-100/T) 1100-1900 kg = 2.2 x 10 ⁻¹⁰ expt-100/T) Proteins (1975) 1100-1900 kg = 1.7 x 10 ⁻¹⁰ expt-100/T) 1100-1900 expt-100-190 expt-100/T) 1100-1900 expt-100-1900 expt-100-190 expt-100/T) Proteins (1975) 1100-1900 expt-100-190 expt-		Washida, et al (1973)	300	$k_{\rm b}$ negligible $k_{\rm b}/k_{\rm a}$ < 0.05	
Moreirs, Mik (1972) Bowen (1973) Bowen (1973) Bowen (1975) Bowen (19		Slagle, Pruss, Gutman (1974)	300	k, = 1.85 ± 0.28 x 10"10	
Perters, Mahnen (1973) Bowman (1975) Bowman (1975) Biordi, et al (1975) Biordi, et al (1975) Biordi, et al (1975) Biordi, et al (1975) Campbell, condann (1978) Singleton, Thrush (1978) Singleton, Cvetanovic (1976) Capped a cappe		Morris, Niki (1972)	300	k(8 + tetramethylethylene) =	
Bormin (1975) Blordi, et al (1975) Canbell, Condann (1975) Canbell, Condann (1975) Barloan, Thrush (1973) Canbell, Condann (1975) Canbell, Canbell Canbell, Canbell Canbell, Canbell Canbell, Canbell Canbell Canbell, Canbell Canb		Peeters, Mahnen (1973)	1100-1900		
Biordi, et al (1975)		Bowman (1975)	1875-2240	kg = 1.7 x 10 10	
Campbell, Goodenn (1975a) 205 3.2 x 10 ⁻¹¹ exp(-2620/T) 4. CH ₃ on Products 4. CH ₃ on Products 8. Herron, Huie (1973) evaluation 4. C ₂ H ₄ - products 8. Herron, Huie (1973) evaluation 9. C ₂ H ₆ - products 9	4	Biordi, et al (1975)	1550-1725	kg = 1.7 x 10=10	
Campbell, Goodman (197a) 295 3.3 x 10 · 1 axp(-2620/T) 295 (campbell, Goodman (197a) 295 (campbell, Goodman (197a) 295 (campbell, Goodman (197a) 200-410 2.3 x 10 · 1 axp (-4850/T) 200-410 2.3 x 10 · 1 axp (-4850/T) (ka · kb) 4 c G ₂ H ₄ · CH ₃ · H ₂ (b) 200-410 200-500 5.5 x 10 · 1 axp (-4850/T) (ka · kb) 300 8 4 c G ₂ H ₄ · CH ₃ · H ₂ (b) 300-392 5.5 x 10 · 1 axp (-4850/T) (ka · kb) 300 8 c x 10 · 1 axp (-4850/T) (ka · kb) 300 8 c x 10 · 1 axp (-4850/T) (ka · kb) 300-392 5.5 x 10 · 1 axp (-4850/T) (ka			1		
Davidson, Thrush (1575) Davidson, Thrush (1575) # Farron, Bule (1975) review # * * * * * * * * * * * * * * * * * *	45.	Goodman (295	, 4 10 • 10 · 10 · 10 · 10 · 10 · 10 · 10 ·	
## ## ## ## ## ## ## ## ## ## ## ## ##	,56	Davidson, Thrush (1975)	300-410	x 10-11	
## C2H4 - CH3 + HCØ (a) ##erron, Hule (1973) evaluation Pruss, Slagle, Gutman (1974) Pruss, Slagle, Gutman (1974) Pruss, Slagle, Gutman (1974) Pruss, Slagle, Gutman (1974) Atkinson, Pitts (1973) evaluation ##erron, Hule (1973) ##erron, Hule (1973) ##erron, Hule (1969) ##erron, Hule (1975) ##erron, Hule (1975) ##erron, Hule (1975) ##erron, Hule (1975) ##erron, Hule (1969) ##erron, Hule (1969) ##erron, Hule (1969) ##erron, Hule (1969) ##erron, Hule (1975) ##erron, Hule (197		*Herron, Hule (1973) review	350-1000	x 10-11	*0-11
#Herron, Huie (1973) evaluation 200-500 E.5 x 10 ⁻¹² exp (-565/T) (k _a + k _b) Pruss, Slagle, Gutman (1974) 300 k _b = 3.81 ± 0.95 x 10 ⁻¹⁴ Atkinson, Pitts (1974) 300-392 5.6 x 10 ⁻¹² exp(-640 ± 100/T) (k _a + k _b) Singleton, Cvetanovic (1976) 298-486 1.16 x 10 ⁻¹¹ exp(-845/T) reproducts #Herron, Huie (1973) evaluation 200-500 4.1 x 10 ⁻¹² exp (-3200/T) Atkinson, Pitts (1974) 200-900 200-900 3.45 x 10 ⁻¹² exp (-3200/T) Singleton, Cvetanovic (1975) 298-483 1.26 x 10 ⁻¹² exp (-38/T) Atkinson, Pitts (1975) 298-462 1.81 x 10 ⁻¹¹ exp (-550/T) k _f x 10 ⁻¹¹ Where N _p , N _s , and N _f are the number of primary, secondary, and tertiary hydrogen atoms, respectively. Atkinson, Pitts (1975) 298-462 1.81 x 10 ⁻¹¹ exp(-215/T) Atkinson, Pitts (1975) 300-392 1.84 x 10 ⁻¹¹ exp(-2100/T) Atkinson, Pitts (1975) 298-462 1.81 x 10 ⁻¹¹ exp(-2100/T)	. 57	$\theta \cdot c_2 H_4 \rightarrow cH_3 \cdot Hc\theta (a)$ $\rightarrow cH_2 c\theta \cdot H_2 (b)$			
Pruss, Slagle, Gutman (1974) Atkinson, Pitts (1974) Singleton, Cvetanovic (1976) Singleton, Cvetanovic (1976) Singleton, Cvetanovic (1976) Singleton, Cvetanovic (1973) 4 • C ₂ H ₆ - products *Herron, Huie (1973) evaluation Atkinson, Pitts (1975) Atkinson, Huie (1969) Atkinson, Pitts (1975)		*Herron, Huie (1973) evaluation	200-500	exp (=565/T) (kg	\$0°0\$
Atkinson, Pitts (1974) Singleton, Cvetanovic (1976) Singleton, Cvetanovic (1976) 298-486 1.16 x 10 ⁻¹¹ exp(-645/±) 300-550 4.1 x 10 ⁻¹¹ exp(-645/±) 6 * C ₂ H ₆ - products *Herron, Huie (1973) evaluation Atkinson, Pitts (1974) Singleton, Cvetanovic (1976) Singlet		Pruss, Slagle, Gutman (1974)	300	0.95 x 10=14	(3)
Singleton, Cvetanovic (1976) Singleton, Cvetanovic (1976) Singleton, Cvetanovic (1976) Singleton, Cvetanovic (1977) Singleton, Huie (1973) evaluation Atkinson, Huie (1973) evaluation Atkinson, Huie (1973) evaluation Singleton, Cvetanovic (1974) Singleton, Cvetanovic (1976) Singleton, Cvetanovic (1	100	ì
Singleton, Cvetanovic (1976) 298-486 1.16 x 10 ⁻¹¹ exp(-845/T) a) Calculated using above recommended value for (k _A · k _b) *Herron, Huie (1973) evaluation 9 · C ₃ H ₆ - products *Herron, Huie (1973) evaluation Atkinson, Pitts (1974) Singleton, Cvetanovic (1976) 9 · C ₃ H ₆ - products *Herron, Huie (1969) Singleton, Cvetanovic (1976) 9 · Alkane - HG · alkyl radical Herron, Huie (1969) 8 · [0.8 exp(-2900/T) N _p · 2.2 exp(-2250/T) N _g · 2.6 exp(-1550/T) N _g is not the number of primary, secondary, and tertiary hydrogen atoms, respectively. 9 · C ₆ H ₆ - products Colussi, et al (1975) Atkinson, Pitts (1975a) 300-392 1.26 c x 10 ⁻¹¹ exp(-200/T) N _g · 2.6 exp(-2250/T) N _g · 2.7 exp(-2250/T) N _g · 2.8 exp(-		Atkinson, Fitts (1974)	300-392	00/T) (K	
#Herron, Huie (1973) evaluation 300-650 4.1 x 10 ⁻¹¹ exp (-3200/T) #Herron, Huie (1973) evaluation 300-650 4.1 x 10 ⁻¹² exp (-38/T) #Herron, Huie (1973) evaluation 300-392 3.45 x 10 ⁻¹² exp (-38/T) Atkinson, Pitts (1973) evaluation 300-392 3.45 x 10 ⁻¹² exp (-38/T) Atkinson, Pitts (1973) evaluation 200-500 4.1 x 10 ⁻¹² exp (-38/T) Atkinson, Huie (1973) evaluation 200-500 4.1 x 10 ⁻¹² exp (-38/T) Atkinson, Huie (1973) evaluation 200-500 4.1 x 10 ⁻¹² exp (-38/T) Atkinson, Pitts (1975) evaluation 300-550 4.1 x 10 ⁻¹¹ exp (-38/T) Atkinson, Pitts (1975) 300-392 1.84 x 10 ⁻¹¹ exp (-2100/T)		Cvetanovi	298-486	w	
#Herron, Hule (1973) evaluation #Herron, Hule (1973) evaluation ##Herron, Hule (1973) evaluation ##Herron, Hule (1974) ##Herron, Pitts (1974) ##Herron, Pitts (1974) ##Herron, Pitts (1974) ##Herron, Pitts (1974) ##Herron, Hule (1969) ##Herron, Hule (1976) ##Herron,	• 58	0 + C2H6 - products		מי שי	
## colusting the first sequents 0 + C ₃ H ₆ - products ##erron, Hule (1973) evaluation 200=500 4.1 x 10 ⁻¹² exp (=38/T) ##erron, Pitts (1974) 300=392 3.45 x 10 ⁻¹² exp(= 150/T) ##erron, Pitts (1974) 298-483 1.26 x 10 ⁻¹¹ exp(=363/T) ##erron, Hule (1969) 250=600 k = [0.8 exp(=2900/T) N _p + 2.2 exp(=2250/T) ##erron, Hule (1969) 250=600 k = [0.8 exp(=2900/T) N _p + 2.2 exp(=2250/T) ##erron, Hule (1969) 250=600 k = [0.8 exp(=2900/T) N _p + 2.2 exp(=2250/T) ##erron, Hule (1969) 250=600 k = [0.8 exp(=2900/T) N _p + 2.2 exp(=2250/T) ##erron, Hule (1969) 298-483 1.81 x 10 ⁻¹¹ exp(=2115/T) ##erron, Hule (1975) 298-462 1.81 x 10 ⁻¹¹ exp(=2115/T) ##erron, Hule (1975) 300=392 1.84 x 10 ⁻¹¹ exp(=2115/T) ##erron, Pitts (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1974) 200=2000/T) 200=2000/T ##erron, Hule (1974) 200=2000/T ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392 1.84 x 10 ⁻¹¹ exp(=2000/T) ##erron, Hule (1975a) 300=392			300-650		*0.11
#Herron, Hule (1973) evaluation 200-500 4.1 x 10 ⁻¹² exp (-38/T) Atkinson, Pitts (1974) 300-392 3.45 x 10 ⁻¹² exp(6 ± 150/T) Singleton, Cvetanovic (1976) 298-483 1.26 x 10 ⁻¹¹ exp(-363/T) 6 * alkane - H6 * alkyl radical Herron, Hule (1969)	\$56				
Atkinson, Pitts (1974) Singleton, Cvetanovic (1976) 9 * alkane - HØ * alkyl radical Herron, Huie (1969) 9 * C ₆ H ₆ - products Colussi, et al (1975) Atkinson, Pitts (1975a) 300-392		*Herron, Hule (1973) evaluation	200-500	4.1 x 10 ⁻¹² exp (-38/T)	±0.08
Singleton, Cvetanovic (1976) 298-483 6 • alkane - H6 • alkyl radical Herron, Huie (1969) 250-600 6 • C ₆ H ₆ - products Colussi, et al (1975) 298-462 Atkinson, Pitts (1975a) 300-392		Atkinson, Pitts (1974)	300-355	$3.45 \times 10^{-1} \text{exp}(\theta \pm 150/T)$	
Herron, Huie (1969) 250-600 6 * C ₆ H ₆ * products Colussi, et al (1975) 298-462 Atkinson, Pitts (1975a) 300-392	09	ngleton,	298-483	1.26 x 10 ⁻¹¹ exp(~363/T)	
 θ * C₆H₆ * products Colussi, et al (1975) Atkinson, Pitts (1975a) 300=392 		rron, Hui	250-600	$k = [0.8 \text{ exp(-2900/T) N}_{p} + 2.2 \text{ exp(-2250/T)}$	
where Np. Ng. and Ng. and Ng. and Ng. and Ng. and Ng. atoms, respectively. ### To not use formula in the notation. ###################################				Ns + 2.6 exp(=1650/T)N _t] x 10=11	
d • C ₆ H ₆ • products Colussi, et al (1975) Atkinson, Pitts (1975a) 298-462 1.81 x 10 ⁻¹¹ exp(-21 exp(-21)				where Np. Ns. and Nt are the number of primary, secondary, and tertiary hydrogen	
6 • C ₆ H ₆ - products Colussi, et al (1975) 298-462 1.81 x Atkinson, Pitts (1975a) 300-392 1.84 x				atoms, respectively.	
Colussi, et al (1975) 298-462 1.81 x 10 ⁻¹¹ Atkinson, Pitts (1975a) 300-392 1.84 x 10 ⁻¹¹	.60a	6 + C.H. + products			
300-392 1.84 x 10-11		Colussi, et al (1975)	298-462	x 10-11	
		Atkinson, Pitts (1975a)	300-392	x 10-11	

	Notes and					(8)			0.1		***				#0°3 (B)		to metch			#0.2 (B)	to match		# C#			(a) novic survey		0.1				*0.1
	Reaction Rate Constant			× 10-11	1.36 x 10 ⁻¹¹ exp(~1560/T)	5.8 x 10 11 exp(-4550/T)		to he unity over same temp, range	×		$2.4 \times 10^{-10} (k_{\rm h} + k_{\rm h})$	(k, +	. 1 s	3	3.5 x 10"11	8.5 x 10-11	(a) 0.41 x k of Heidner and Husain; scaled to	other selected of D) rates	0	1,0 X 10 10 10 10 10 10 10 10 10 10 10 10 10	:	other selected #(-D) rates	2.0 × 10-11 exp(107/T)	x 10-11		3.5 x 10 ⁻⁷ cm molecule s ⁻⁴ (a) Derived from data in Rajimoto and Cvetanovic (1976a) and value of $K(\theta^1D) + N_2$) this survey		$1.1 \times 10^{-10} (k_{A} + k_{b})$	10-10 (kg +	1		2.5 x 10-10
	Temp.			298-462	300-392	500-1000	298-443		104-354	300	103-393	300	300		300	300			ć r	380))		104=254	300		300		204=359	300	300		204=354
1977	Reaction/Reference	+ NASA (1977) eval	g + C _{6 H5} CH ₃ → products	Colussi, et al (1975)	Atkinson, Pitts (1975a) Ø + CH ₃ Cl → HØ + CH ₂ Cl	Westenberg, deHaas (1975a)	Barassin, Combourieu (1974)	$\theta(^{1}D_{2}) + \theta_{2} - \theta_{2}(^{1}\Sigma_{n}^{+}) + \theta(^{3}P)$	+*Streit, et al (1976)	Fletcher, Husain (1976b) $\theta(^1D_2) + \theta_3 + \theta_2 + \theta_2$ (a) θ	t*Streit, et al (1976)	Beidner, et al (1973)		$\theta(^1D_2) + N\theta + N\theta + \theta(^3P)$	This survey	Heldner, Husain (1973)		6(1D2) + N6 - N6 + 62		Inis survey Heldner, Hussin (1973)		$\theta(^{1}D_{2}) + N_{2} \rightarrow N_{3} + \theta(^{3}P_{3})$	+*Streit et al (1976)	Heldner, et al (1973)	25.	+*NASA (1977) eval	$\theta(^{1}D_{2}) + N_{2}\theta + N_{2} + \theta_{2}$ (a) $+ 2N\theta$ (b)	1977)	Heidner, Husain (1973)	+*Cvetanovic (1975) review	$\theta(^1D_2) + NH_3 \rightarrow NH_2 + H\theta$	*Davidson, et al (1977)
December 1977		No.			1,64			2,4		2,7				2,9				2.10				2,12		70.0	E 2 4 6 7		2,13				2,17	

No. FreeEntrace Towns. Panely	December 1977				
(1, 1) 1, 10 1 1 1 1 1 1 1 1 1			Temp.		Notes and
1	No.	- NASA (
# **Day(adea, et al (1973) 2	2,21	$\theta(^{1}D_{2}) + H_{2} \rightarrow H\theta + H$			
Heidener, Housin (1973) 300 2.7 x 10 ¹⁰ Heidener, et al (1976) 223-323 2.3 x 10 ¹⁰ Heidener, et al (1976) 223-323 2.3 x 10 ¹⁰ Heidener, et al (1976) 300 5.2 x 10 ⁻¹⁰ Heidener, et al (1977) 190-379 1.4 x 10 ⁻¹⁰ Heidener, et al (1977) 300 3 x 10 ⁻¹¹ Heidener, et al (1978) 300 3 x 10 ⁻¹¹ Heidener, et al (1978) 300 3 x 10 ⁻¹¹ Heidener, et al (1978) 300 3 x 10 ⁻¹¹ Heidener, et al (1978) 300 3 x 10 ⁻¹¹ Heidener, et al (1978) 300 3 x 10 ⁻¹¹ Heidener, et al (1978) 300 3 x 10 ⁻¹¹ Heidener, et al (1978) 300 3 x 10 ⁻¹¹ Heidener, et al (1978) 300 3 x 10 ⁻¹⁰ Heidener, Hosain (1978) 300 3 x 10 ⁻¹⁰ Heidener, Hosain (1973) 300 3 x 10 ⁻¹⁰ Heidener, Hosain (1978) 300 3 x 10 ⁻¹⁰ Heidener, Hosain (19		+*Davidson, et al (1977)	204=352	×	
# # # # # # # # # # # # # # # # # # #	2,22	Heidner, Husain (1973) $\theta(^1D_2) + H_2\theta \rightarrow 2H\theta$	300	×	
Heldrine, et al (1973) 300 3.0 x 10 ⁻¹⁰ 6(¹ D ₂) + ¹ D ₂ ² + 10 + ¹ D ₂ 1.4 x 10 ⁻¹⁰ 6(¹ D ₂) + ¹ C ₂ + C ₂ + C ₃ + C ₄ + C ₄ 10 + ¹ D ₂ 1.4 x 10 ⁻¹⁰ 1.4 x 10 ⁻¹⁰ 6(¹ D ₂) + C ₂ + C ₃ + C ₄		+*Streit, et al (1976)	253-353	×	±0.1
Fleether, Husain (1978a) 300 5.2 × 10 ⁻¹⁰	2,23	Heidner, et al (1973) $\mathfrak{G}(^1D_2)$ + $H_2\mathfrak{G}_2$ - $H\mathfrak{G}$ + $H\mathfrak{G}_2$	000	×	
## ## ## ## ## ## ## ## ## ## ## ## ##	2,39	Fletcher, Husain (1976a) $\theta(^1D_2)$ + HCl - products	300	. 2 ×	
### sequence, et al (1973) ### sequence, et al (1973) ### sequence, et al (1976) ### second	2,45	$f*Davidson, et al (1977)$ $G(^1D_2) *CG * CG * G(^3P)$	199-379	4 K	# 0 • 1
Heidner, et al (1973) 6 6(1 _{D2}) + C6 ₂ - C6 ₂ + 6(3 _P) 6 55relt, et al (1976) 6 55relt, et al (1976) 6 55relt, et al (1976) 7.3 x 10 ⁻¹¹ 7.3 x 10 ⁻¹¹ 8 55relt, et al (1976) 7.3 x 10 ⁻¹⁰ 7.3 x 10 ⁻¹⁰ 8 61 ¹ D ₂) + C6 ₂ - C6 ₂ + 6(3 _P) 8 61 ¹ D ₂) + C6 ₂ - C6 ₂ + 6(3 _P) 8 61 ¹ D ₂) + C6 ₃ - C6 ₃ - C6 ₃ + 66 (a) 8 61 ¹ D ₂) + C6 ₄ - C6 ₃ - C6 ₃ + 66 (a) 8 61 ¹ D ₂) + C6 ₄ - C6 ₃ - C6 ₃ + 66 (a) 8 61 ¹ D ₂) + C6 ₄ - C6 ₃ - C6 ₃ + 66 (a) 8 61 ¹ D ₂) + C6 ₄ - C6 ₃ - C6 ₃ + C6 ₃ - C6 ₃ + C6 ₃ - C6		* Aller	006	*	#0.3 (a)
6 (¹ D ₂) + Cq ₂ - Cq ₂ + θ(³ P) 8 Streit, et al (1976) 8 Streit, et al (1976) 9 Streit, et al (1976) 139-200 1.2 x 10 ⁻¹⁰ 1.7 x 10 ⁻¹⁰ 1.7 x 10 ⁻¹⁰ 1.7 x 10 ⁻¹⁰ 1.7 x 10 ⁻¹⁰ 1.8 x 10 ⁻¹⁰ 1.8 x 10 ⁻¹⁰ 1.9 x 10 ⁻¹⁰ 1.1 x 10 ⁻¹⁰ 1.1 x 10 ⁻¹⁰ 1.2 x 10 ⁻¹⁰ 1.2 x 10 ⁻¹⁰ 1.3 x 10 ⁻¹⁰ 1.4 x 10 ⁻¹⁰ 1.5 x 10 ⁻¹⁰ 1.6 x k _b 1.7 x 10 ⁻¹⁰ 1.8 x 10 ⁻¹⁰ 1.9 x 10 ⁻¹⁰ 1.9 x 10 ⁻¹⁰ 1.1 x 10 ⁻¹⁰ 1.1 x 10 ⁻¹⁰ 1.2 x 10 ⁻¹⁰ 1.2 x 10 ⁻¹⁰ 1.3 x 10 ⁻¹⁰ 1.4 x 10 ⁻¹⁰ 1.4 x 10 ⁻¹⁰ 1.5 x 10 ⁻¹⁰ 1.7 x 10 ⁻¹⁰ 1.8 x 10 ⁻¹⁰ 1.8 x 10 ⁻¹⁰ 1.8 x 10 ⁻¹⁰ 1.9 x 10 ⁻¹⁰ 1.9 x 10 ⁻¹⁰ 1.9 x 10 ⁻¹⁰ 2.1 x 10 ⁻¹⁰ 2.2 x 10 ⁻¹⁰ 2.2 x 10 ⁻¹⁰ 2.3 x 10 ⁻¹⁰ 2.3 x 10 ⁻¹⁰ 2.4 x x 10 ⁻¹⁰ 2.5 x 10 ⁻¹⁰ 2.8 x 10 ⁻¹⁰ 2.9 x 10 ⁻¹⁰ 2.1 x 10 ⁻¹⁰ 2.1 x 10 ⁻¹⁰ 2.2 x 10 ⁻¹⁰ 2.2 x 10 ⁻¹⁰ 2.3 x		Heidner, et al (1973)	300	• ×	
## Streit, et al (1976) ## Streit, Husain (1975) ## Streit, Husain (1975) ## Streit, et al (1976) ## S				0.41 x k of Heidner, et al;	tch
Fletcher, Husain (1976) Fletcher, Husain (1976) G(¹ D ₂) + CH ₄ - CH ₃ + HG (a) +ebbvidson, et al (1977) Heidner, Husain (1978) Heidner, Husain (1978) Heidner, Husain (1978) Heidner, Husain (1973) Heidner, Husain (1973) Heidner, Husain (1973) Heidner, Husain (1973) Heidner, Husain (1976) Heidner, Husain (1978) Heidner, Husa	2,46	•		(a)o mainaine	
Fletcher, Fusain (1976b) 300 1.7 x 10-10 (kg + kb)		*Streit, et al (1976)	139-200	×	±0.1
Fletcher, Husain (1976b) 6 (1b2) + CH4 - CH3 + He4 (a) +*Davidson, et al (1977) Heidner, Husain (1973) **This survey **Th			200=354	x 10-11	±0.1
#eidner, Husain (1973) #eidner, Husain (1973) #erdner, Husain (1973) #erdner, Husain (1973) #erdner, Husain (1975) #erdner, Husain (1975) #erdner, Husain (1975) #erdner, Husain (1976a) #erdner, Husain (1976a) #erdner, Husain (1976b) #erdner, Husain (1976a) #erdner, Husain (1976b) #erdner, Husain (1976b) #erdner, Husain (1976a) #erdner, Husa	2,55	76b) HG (e	0 0 m	×	
Heidner, Husain (1973) Heidner, Husain (1975) review Heidner, Husain (1975) review Herdretanovic (1976) Herdretanovic (1976		+*Davidson, et al (1977)	198-357	x 10-10 (Kg	
#This survey #This survey #This burvey #This burvey #This burvey #This burvey #This burvey ##NASA (1977) eval ##NASA (1976b) ##NASA (1977) eval ##NASA (1978a) ##NAS		Heidner, Husain (1973)	00 m	10-10 (kg	
#This survey Fletcher, Husain (1976a) Pletcher, Husain (1976a) 900 7.3 x 10 ⁻¹⁰ (a) 0.41 x k of Fletcher and Husain; scaled to match other selected of (¹ D) rates +*NASA (1977) eval Fletcher, Husain (1976b) 900 2.3 x 10 ⁻¹⁰ (a) 0.41 x k of Fletcher and Husain; scaled to match other selected of (¹ D) rates (a) 0.41 x k of Fletcher and Husain; scaled to match other selected of (¹ D) rates (a) 0.41 x k of Fletcher and Husain; scaled to match other selected of (¹ D) rates (a) 0.41 x k of Fletcher and Husain; scaled to match other selected of (¹ D) rates (a) 0.41 x k of Fletcher and Husain; scaled to match other selected of (¹ D) rates (a) 0.41 x k of Fletcher and Husain; scaled to match other selected of (¹ D) rates Slanger, Black (1976a) 200-365 Stander, Black (1976a) 200-377 4.3 x 10 ⁻¹¹ every (-350/T) 4.3 x 10 ⁻¹² 200-377 4.3 x 10 ⁻¹³ 200-377 4.3 x 10 ⁻¹⁴ 200-377 4.3 x 10 ⁻¹⁵ 200-377 4.3 x 10 ⁻¹⁶ 200-377 4.3 x 10 ⁻¹⁷ 200-377 4.3 x 10 ⁻¹⁸ 200-377	2,58	#(1D2) + C2H6 - products		Q #	
Fletcher, Husain (1976a) Fletcher, Husain (1976b) (a) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates +*MASA (1977) eval Fletcher, Rusain (1976b) (b) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (a) 0.44 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (b) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (c) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (d) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (d) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (d) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (d) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (a) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates (a) 0.41 x k of Fletcher and Husain; scaled to match other selected 6(¹ D) rates		*This survey	300	×	±0.2 (a)
## ASA (1977) eval ## Fletcher, Husain (1976b) ## (1977) eval ## (1976b) ## (1977) eval ## (1976b) ## (1976a) ## (1976b) ## (1976a) ## (1976b) ## (1		Fletcher, Husain (1976a)	300		
#*NASA (1977) eval #*NASA (1977) eval #*NASA (1977) eval Fletcher, Husain (1976b) #*O.41 x k of Fletcher and Husain; scaled to match other selected #(¹D) rates #*NASA (1977) eval #*NASA (1977) eval #*NASA (1977) eval Fletcher, Husain (1976b) #*O.41 x k of Fletcher and Husain; scaled to match other selected #(¹D) rates #*O.25 x 10 - 10 ca) 0.41 x k of Fletcher and Husain; scaled to match other selected #(¹D) rates #*O.25 x 10 - 11 store = 10 - 12 Slanger, Black (1976a) \$ 200-365				0.41 x k of Fletcher other selected $\theta({}^{1}D)$	to match
+*NASA (1977) eval Fletcher, Husain (1976b) 900	2,61	6(102) * CF2Cl2 * products			
Fletcher, Rusain (1976b) 300 4.8 x 10 ⁻¹⁰ (a) 0.41 x k of Fletcher and Rusain; scaled to mat other selected $\theta(^{1}D)$ rates (a) 0.41 x k of Fletcher and Husain; scaled to mat other selected $\theta(^{1}D)$ rates +*NASA (1977) eval		+*NASA (1977) eval	300	×	±0.2 (a)
(a) 0.41 x k of Fletcher and Husain; scaled to mat other selected $\theta(^{1}D)$ rates +*NASA (1977) eval		Fletcher, Husain (1976b)	300	x 10-10	
##NASA (1977) eval ##NASA (1977) eval ##NASA (1977) eval Fletcher, Husain (1976b) ##NASA (1977) eval ##NASA (1978) eval				0.41 x k of Fletcher other selected $\theta(\ D)$	to match
+*NASA (1977) eval +*NASA (1977) eval Fletcher, Husain (1976b) 5.5 x 10 ⁻¹⁰ (a) 0.41 x k of Fletcher and Husain; scaled to mat other selected #(\frac{1}{D}) rates 6(\frac{1}{S}) + 6(\frac{3}{P}) + ? Slanger, Black (1976a) 200-365 5 x 10 ⁻¹¹ exp(-305/T) #(\frac{1}{S}) + 62 + ? 200-377 4.3 x 10 ⁻¹² exp(-850/T)	2,62	$\theta(^1D_2) + CFCl_3 + products$			
Fletcher, Husain (1976b) 300 5.5 x 10 ⁻¹⁰ (a) 0.41 x k of Fletcher and Husain; scaled to mat other selected $\mathcal{H}(^1D)$ rates $\mathcal{H}(^1S) + \mathcal{H}(^3P) + \mathcal{H}(^3P$		+*NASA (1977) eval	300		±0.2 (a)
(a) 0.41 x k of Fletcher and Husain; scaled to mat other selected $\theta(^1D)$ rates Slanger, Black (1976a) 200-365 5 x 10^{-11} exp(-305/T) $\theta(^1S) + \theta_2 + \gamma$ 200-377 $\Delta_{\bullet,3} \times 10^{-1}$ exp(-850/T)			300	x 10 110	
$\theta(^{1}S) + \theta(^{3}P) + \gamma$ Slanger, Black (1976a) 200-365 5 x 10 ⁻¹¹ exp(-305/T) $\theta(^{1}S) + \theta_{2} + \gamma$ 200-377 4.3 x 10 ⁻¹² exp(-850/T)				0.41 x k of Fletcher and Husain; scaled	to match
Slanger, Black (1976a) 200-365 5 x 10^{-11} exp(-305/T) $\theta(^{1}S) + \theta_{2} \rightarrow ?$ 200-377 $\Delta_{*}3 \times 10^{-1}^{2}$ exp(-850/T)	3°5	$\theta(^1S) + \theta(^3P) + \gamma$		serected 7(D)	
$\theta(^{4}S) + \theta_{2} + ?$ 200-377 $^{4}S \times 10^{-3} c exp(-850/T)$		Slanger, Black (1976a)	200-365	5 x 10 ⁻¹¹ exp(~305/T)	
	4° E		200-377	$\Delta.3 \times 10^{-1} < \exp(-850/T)$	#0.15 a

December 1977	. 1977				
	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and	
	* * Preferred Value	Range/K	k/cm ² molecule ³ s ³ 1	Reliability of	
No.	+ * NASA (1977) eval			log k	
3,7	6(1s) + 6 ₂ + ?	340	5.8 x 10-10	±0.07 a	
0	of to 1 + No to 2	200=201	3.0 2.10-11(4.10.5	4	
3,10	+ NG2 +	300	S x 10 10	# C . C .	
3,12	0(1s) + N ₂ + ?	200-380	< 5 x 10=17	ď	
3,13	6(1s) + N20 - P				
	ge	200=368	3.8 x 10"11 exp(=420/T)		
3,17	6(1s) + NH2 + P	300	5 x 10*10	#0.2 B	at
3,22	θ(1s) + H ₂ θ → ?				
	Bingham et al (1976)	000	1.3 × 10"10		
3.46	6(1s) + ce. + ?	200-450	3.1 x 10=11exp(=1320/T)	*0.1 F	æ
7 2 2	1 H	00	41-01-01-01-01-01-01-01-01-01-01-01-01-01		
2	4 7 6))	a) Rate constants ovaluated for this survey	t •	
			by T. G. Slanger and K. H. Welge (
4, hv	$\theta_2 + h\nu \rightarrow \theta(^3P) + \theta(^3P)$				
	pson,		β = 1 175 < λ < 200 nm		
4,hv	• 6(3P) • 6(1D				
	Hampson, et al (1973a) review		pt = 1 133 < A <175 nm		
4,hv	62 + hv → 2 oxygen atoms				
	Hampson, et al (1973a) review		Ø = 1 106 < \lambda < 200 nm		
4 , hv					
	Hampson, et al (1973a) review		Recommended values of absorption cross section		
α	1 2		۶ ۲		
)))				
4,9,9	82 + NG + NG - NG2 + NG2				
	ulch, et al (1973	273-660	3.3 x 10 39 exp(530/T) cm ⁶ molecule 2s 1	±0.2	
	dman, Niki (1973)	300	2.0 x 10 38	±0.1	
4,9,10	62 + NG + NG2 - NG2 + NG3		see reverse reaction		
6,0	62 + NG + N62 + 6		see reverse reaction		
£ 0. * t	S FON B ON CO				
	Baulch, et al (19/3) review		No recommendation		
4,10	NOS + NO				
4,11	02 + NO3 + NO2 + O3		see reverse reaction		
J , 6	200		010		
	*Baulch, et al (1973) review	1200-2000	1.0 x 10 " exp(=55.2 x 10 /T)	#0.4 (a)	_
81.4	† H + (0)		see reverse reaction		
4,18M	¥ :				
N °ON	• ==				
	+*This Survey	203-404	$k_f = 6.7 \times 10^{-33} \text{ exp(290/T) cm}^6 \text{molecule}^2 \text{s}^{-1}$	±.07 (a)	_
			M = Ar or He, k(300) = 1.8 x 10 = 32		
			Rel. M efficiencies: Ar(1.01, He(1.01, N ₂ (3.11), O ₂ (3.11),	, 62(3.1),	

December 1977	1977			
	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and
	· Prefe	Range/K	k/cm [*] molecule ¹ s ¹	Reliability of
No.	+ = NASA (1977) eval			log k
			(a) This evaluation is based on the 300 K data reviewed	ta reviewed by
			Haulch, et al (1972) and the recent studies by Hikida et al (1971). Kurwlo (1972) and Wong and	studies by
			Davis (1974).	0
	Baulch, et al (1972) eval.	300-2000		۵۰ 4
			. W eff.: Ar(1.	.3), H26(21)
			x 10 9 exp(-23000/T) M =	Ar ±0.2
	Bishop, Dorfman (1970)	300	kg = 2.35 x 10=32 M = Ar	
	Hikida, Eyre, Dorfman (1971)	300	1.64 x 10=32 M = Ar	
	Ahumada, Michael, Osborne (1972)	300	0.75×10^{-32} M = He	
			encies: He(1.0), Ar(0.8)	
	Allen, Moortgat (1973)	115-300	1.4(*0.14) x 10> exp(*700(*50)/T), M = Ar Rel. M eff.: at 297K; Ar(1.0), He(0.97), H ₂ (1.28),	(1,28).
	Mary to (1972)	*0*=°0×	e. x 10 exp(255/1) Rel. M eff.: Ar(1.0), He(1.0), N ₂ (3.4)	
		035-060	1	
	wong, Davis (15/4)	220=350		
			(8 0) % (8	(21.5)
			• ner •	
	Westenberg, deHaas (1972a)	300	•	
	Slack (1977)	980-1176	$(9.1*1.6) \times 10^{-3}$ M = N ₂	
		964-1075	×	(a)
		200-2000	1.85 x 10 - CT - 1.72 M = N2	(a)
		200-2200	5.8 x 10 ⁻³⁰ T ⁻¹ M = Ar	(p)
			(a) reanalysis of literature	
			(b) recommendation based on this work	
			and data from literature	
4,21	62 + H2 + H + H62		see reverse reaction	
4,21	72 + H2 + H0 + H0			
4.22	- HG . + HG			
•	Baulch, et al (1972) review		no recommendation	
4.23	62 + Н202 - Нб2 + Нб2			
	Baulch, et al (1972) review		no recommendation	
4,24	$\theta_2 + HN\theta - N\theta + H\theta_2$			
	Demerjian, et al (1974) review	300	< 2.1 x 10-20, E/R > 5000K	estimated
4,27	62 + SG + SG2 + G		see reverse reaction	
4,31				
	itt, Glass (1974)	295	× 10 13	
4,35M 37,M	$\theta_2 + Cl + M + Cl\theta\theta + M (f)$ $Cl\theta\theta + M + Cl + \theta_2 + M (f)$			
	+NASA (1977) eval	006-006	k = 5.8 x 10 ⁻⁹ exp(=3580/T)	(+2, =!) (a)
			7 (4)	

December 1977	Beaction/Reference	Temp	Doseting Date Constant	W- 4 cc 2 cd
	* Preferred Value + " NASA (1977) eval	Range/K	K/cm ³ molecule ¹ s ³ 1 R	Notes and Reliability of log k
	+Nicholas, Norrish (1968)	293	kf - 1.7 x 10 ⁻³³ cm ⁶ molecule -2s-1	
	Clyne and Coxon (1968)	300		
	Stedman (1968)	200-300		(4)
	62 + CN + NCØ + Ø			
	Albers, et al (1975) 6, + CH6 - C6 + H6,	275=398	5.3 x 10 ⁻¹¹ exp(-500*170/T)	
	+*Washida, et al (1974)	297	K/K(0 + CH0) = 2.74 ±0.21 x 10=2	
	Demerjian, et al (1974) review	300	Vietoring K = 0.7 *1.0 X 10 1	estimated
	62 + CH ₂ + CH ₂ 6 + H6		5 4 6 6	
	Washida, Bayes (1976)	259-341	2.9 x 10 ⁻¹³ exp(-940/T)	
	Basco, et al (1972)	29 <i>5</i>	3 x 10 10 a. Based on negative result and sensitivity limit. measurements at higher T suggest an appreciable	estimated (a) mit. Other able
	$\theta_2 + CH_3(+M) + CH_3\theta_2(+M)$		• Du 1010 1010 1010 1010 1010 1010 1010 1	
	Laufer, Bass (1975)	s 528	10 ¹² x k P(N ₂)/torr 0.45 50 0.7 100 1.2 700	3
	Washida, Bayes (1976)	300	5.0 x 10"13 1.9 x 10"31cm ⁶ molecule"2s" w = N ₂	<u> </u>
	Hochanadel, et al (1977)	295	x 10-12	(p)
	Basco, et al (1972)	295	5.1 x 10=13 2.6 x 10=31 cm ⁶ molecule=2s=1 y = N ₂	(e) (c)
	van den Bergh, Callear (1971)	295	x 10-12 10-31 cm ⁶ molecule-2s-1 w =	
			(a) Values are based on k(CH ₃ + CH ₃) = 9.5 x 10 ⁻¹¹ , given in Bass, Laufer (1973). (b) 2nd order high pressure limit.	
	$r_2 + cH_3\theta +$		CH ₃ 6	
·	*Hampson, et al (1973) review	285=322	2.2 x 10-18 (T/300)0.8 M - 62	# · O #
	Huestis, et al (1974)		1.1 x 10=18 (a) Liquid phase. When combined with gas phase data of Findlay and Snelling (1971a) (summarized in Hampson, et al (1973) k = 2.2 x 10=18 (T/30))0.5	Ĝ

December 1977	1977			
	action	Temp.	Reaction Rate Constant	
	· Prefe	Range/K	k/cm/molecule ts 1	_
No.	+ = NASA (1977) eval			tog k
	# 40 000 mell#	, m	N - N 08-01 - 6 >	
	Collins, et al (1973)	300	3.4 x 10 17, M N2	≠ 0°0€
	*Penzhorn, et al (1974)	300	Z	
		300	×	
	Penzhorn, et al (1975)	300	1018 M	
		,		
			m	
			1.01 CH2Cl	
			0.87 CH3CL2	
	Breckenridge, Miller (1972)	300		(a)
	Flaher McCarty (1966)	000		(8)
			total rate.	
5.7	$\theta_{s}(1_{\Delta}) + \theta_{s} - 2\theta_{s} + \theta$			
•		4 - 00		4
	Title Jones, Wayne (1970)	1958459	x 10	t 2 • 0 •
	Find tay, Shelling (19/1)	263=321	x 10	11.04
	Becker, et al (1972)	296-360	×)
	Collins, et al (1973)	300	× 10 ×	#0° 13
	Schoffeld (1972) review	283-321	4.5 x 10 ⁻¹¹ exp(~2830/T)	±0•11
വ ജ	$\theta_2(^4\Delta) \cdot N - N\theta \cdot \theta$			
	Schmidt, Schiff (1973)	300	K(N + 62 + NG +	probably
	Westenberg, et al (1970)	195-300	$k \leftrightarrow k(N + \theta_2 + N\theta + \theta)$	
	Clark, Wayne (1970)	195-431	$k = 2 \times 10^{-14} \exp(-600/T)$	(a)
			(a) probably refers to physical deactivation,	
	•		not chemical reaction; see above refs	
5,9	$\theta_2(^1\Delta) + N\theta \rightarrow \theta_2 + N\theta(v > 0)$			
	*Becker, et al (1971)	300	4.5 x 10 17	*0.15
	Yaron, et al (1976)	300	2.5 x 10-17	±0.1
	Glachardi, et al (1976)	293	(4.5 ± 1) x 10 ⁻¹ /	
	Ggryzlo, Thrush (1973)	300	NG(v • 4) observed	
5,18	θ ₂ ('Δ) + H + products			
	Schmidt, Schiff (1973)	300	(2.5±0.5) x 10-14	(a)
			(a) expt could not distinguish between	
			chemical rxn and physical quenching	
5,27	Westenberg, et al (1970) $\theta_2(^1\Delta) + SG \rightarrow \theta_2 + SG(^1\Delta)$	300	rxn to give H6 . A as products not observed	
× 9	Breckenridge, Miller (1972) $G_{\lambda}(1_{\Sigma}) + M + G_{\lambda} + M$	300	3.5 t 0.36 x 10-13	
	2	i i	16	6
	*Hampson, et al (1973) review	300	x 10 10, x	Z I • 0 •
			2.0 x 10-* 3 % * N2	#0.1
			4 x 10 12, M = H26	±0.18

* = Preferred Value	Range/K	ž.	k/cm ³ molecule 1s 1	nstant 1s-1	Į.	Reliability of
	0					
$\theta_3 + hv + \theta(^3P) + \theta_2(^3z_g^*)$		1				
*Hampson, et al (19/3) review		* c	450 x x x x 0 nm - Chappuis bands	- Chappuis	bands	
Johnston (1973)		K = 3.39	k = 3.39 x 10 4s 1 (Daylight)	ylight)		
		(450 ×)	(450 × 150nm - Chappuis bands)	uis bands)		
$\theta_3 + h\nu + \theta(P) + \theta_2(A \text{ or } \Sigma)$ *This survey		% = 0. X <303nm	### SOC >			
		Total qu	Total quantum yield (63p	3p + 61D) equals	uals	
$\theta_2 + h\nu - \theta(1D) + \theta_2(1\Delta)$		unity fo	unity for 3034 A 4350nm	8		
+*Lin, DeNore (1973)		A/nm	Ø 6(1p)	γ\n	g 6(1D)	(e)
		₹303	1.00	310	0.25	
		304	66*0	311	0.15	
		305	0.95	312	0.10	
		306	06.0	3 5 3	0.07	
		307	0.80	et en	0.04	
		308	0.55	315	0.02	
		309	0.35	2316	0	
		(a) As	As tabulated in review by Molina (1977)	eview by Mol	ina (1977)	
		Rel	Relative values norm, to Ø = 1 for A <300nm	orm, to Ø =	1 for A <300	mu(
Hampson, et al (1973) review		See for	for discussion of earlier work	earlier work		
*Hempson of al (1673) review			0 250 × 3 × 350 mm			
THE PROPERTY OF THE PROPERTY O						
63 + M + M 6 + 62 + M 6		see reve	reverse reaction			
+*NASA (1977) eval	200-300	2 x 10-1	2 x 10-11 exp(-1070/T)			#0.3 at 230K
		(a) Acc	Accepts room temp.		ulch	
		٧.	"A factor" chosen;	; Eact derived	pe	
Baulch, et al (1973) review	300	5.7 x 10"13	-13 -13			±0.2
θ_3 + N θ + N θ_2 + θ_2 (1) θ_2 + N θ_2 + N θ + θ_3 (1)						
+*NASA (1977) eval	200-300	kf = 2.1	2.1 x 10-12 exp(-1450/T)	1450/T)		±0.15 (a)
			based on results in Birks et al (1976). "A factor" derived from reconsideration	in Birks et d from recon	976).	Lower
			mary data	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	ĺ	
	203-361	,	Z.34±0.23 X 10 exp(_1+30+30/1)	X 10 EXP(-1#50#50/1)	0/1/	
nampson, et at (1973) review	000-061	,	or dxa or	00/11 CH HOL	s elnoe	1 T • O #
Stedman, Niki (1973)	298	kg = 1.7	= 1.73 ±0.1 x 10=14			#0°5
Baulch, et al (1973) review	200=350	Ke = 1.5	= 1.5 x 10 ⁻¹² exp(-1330/T)	1330/T)		\$0°5
	200-350	K. * K.	* k+/K, = 2.8 x 10-12	-12 exp(-25400/T)	00/T)	*0.2
Ghormley, et al (1973)	298	Kg = 1.4	= 1.41 x 10=14			
Bemand, et al (1974)	300	k_ = 1.8	= 1.81 ±0.13 x 10-14	4		
			410			

December 1977	1977 Reaction/Reference	Temp.	Reaction Rate Constant	Notes and
° o N	+ = Preferred Value + = NASA (1977) eval	Range/F.	k/cm ³ molecule ⁻¹ g ⁻¹	Reliability of log k
o 	$\theta_3^+ + N\theta - N\theta_2^{-\theta}(^2B_{1,2}) + \theta_2^{-\theta}(^2)$ $ - N\theta_2^{-\theta}(^2A_1) + \theta_2^{-\theta}(^2)$ $ - \theta_3^{-\theta} + N\theta^{-\theta}(^2S)$ Kurylo, et al (1975) Bar=Zly, Moy, Gordon (1978) Hui, Cool (1978)	153-373 158-437 138-410	see discussion see discussion k ₁ = 1.0 x 10 ⁻¹² exp(=1450/T) k ₂ = 3.8 x 10 ⁻¹³ exp(=520/T). k ₃ = 1.1 x 10 ⁻¹³ at 333 K and at 143 K with minimum value of 0.62 x 10 ⁻¹³ at approx. 230K Discussion Neasured quantity in all studies is (k ₁ * k ₂ * k ₃). Values of this quantity measured by Kurylo et al and by Hui, Cool are in good agreement; values reported by Bar=Ziv, Moy and Gordon are systematically higher below 300K. Hui and Cool derived values as a function of temperature tor k ₁ , k ₂ , and k ₃ given above from an analysis of the temperature dependent data for (k ₁ * k ₂ * k ₃) reported by the three groups, the temperature dependence of the enhancement factor for rxn channel (1) reported by Moy, Bar=Ziv and Gordon (1977), their own temperature dependent data for the ratio of the enhancement factors for rxn chennels (1) and (2) and the rate constant for channels (1) and (2) for thermal ozone reported by Clough and	k3). al and by ed by her emperature g of the e of the for rxn channels
ν φ ω ω ω ω ω ω	θ ₃ + Nθ ₂ - Nθ ₃ + θ ₂ (f) θ ₂ + Nθ ₃ - θ ₃ + Nθ ₂ (r) +*NASA (1977) eval Davis, Prusazcyk, Dwyer, Kim (1974) Graham, Johnston (1574) Huie, Herron (1974a) Baulch, et al (1973) review Wu, Morris, Niki (1973) Ghormley, et al (1973) Stedman, Niki (1973) Becker, Schurath, Seitz (1974)	220=340 260=343 231=298 259=362 286=302 300 299 298 298	Thrush (1967) k _f = 1.2 x 10 ⁻¹³ exp(-2450/T) k _f = 9.76 ± 0.54 x 10 ⁻¹⁴ exp(-2456 ± 30/T)) k _f = 1.34 ± 0.11 x 10 ⁻¹³ exp(-2466 ± 30/T)) k _f = 1.57 ± 0.41 x 10 ⁻¹³ exp(-2509 ± 76/T)) k _f = 9.8 x 10 ⁻¹² exp(-3500/T) k _f = 7 x 10 ⁻³⁴ based on k _f k _f = 3.2 x 10 ⁻¹⁷ k _f = 3.2 x 10 ⁻¹⁷ k _f = 3.24 x 10 ⁻¹⁷ k _f = 3.24 x 10 ⁻¹⁷ (a) Perived by combining results from the three 1974 temperature dependent studies (b) Rased on Johnston, Yost (1949) (c) Revision, based on later experiments, of value reported by Stedman and Niki (1973)	±0.1 (a) ±0.7 (b) ±0.06 (c) ±0.07

December 1977	r 1977			
	Re	Temp.	Reaction Rate Constant	
No.	* * Preferred Value + * NASA (1977) eval	Range/K		Reliability of log k
7,18	Ø3 + H + HØ + Ø2			
	yne,	298-638	<pre>1.0 ± 0.2 x 10⁻¹⁰ exp(-516 ± 60/T) (a) NASA (1977) evaluation selected preliminary value reported by these authors, k = 1.2 x 10⁻¹⁰ exp(-550/T) with Alog k</pre>	*0.2 (a)
	Lee, et al (1978) Phillips, Schiff (1962)	219-360	increased to 10.3 at 230K. 1.3 ± 0.3 x 10 ⁻¹⁰ exp(-449±58/T) 2.6 ± 0.5 x 10 ⁻¹¹ (b) Quoted by Fampson, et al (1973) review and	.
7,19	θ_3 + H θ - H θ_2 + θ_2 + +*NASA (1977) eval	200-300	Baulch, et al (1976) review 1.5 x 10 ⁻¹² exp(-1000/T) (a) Adjusted from recommendation in Hampson et al (1973) review because of error in derivation of	*0.3 (a) : al on of
	Hampson, et al (1972) review Anderson, Kaufman (1973) Baulch, et al (1976) review DeMore (1973)	220-450 220-450 300 300 271-333	1.6 x 10-12 exp(-1000/T) 1.3 x 10-12 exp(-956/T) 6.5 x 10-14 8 x 10-14 8 x 10-14 8 x 10-14	() () () () ()
7,19	.Davis (1976) Kurylo (1973) $\theta_3 + B\theta(v_1 > 0) + products$	300	7.5 ± 0.3 x 10=14 6.5 x 10=14	90°3#
	Coltharp, Worley, Potter (1971) Streit, Johnston (1976)	O O M	Y ₁ (H¢) 10 ¹² X K(300 K) CWP SJ 2 1.9*1.1 2 2.4*0.9 4 2.8*0.8 3.7*0.1 5 3.4*0.7 4.5*0.1 6 5.3*0.6 7.1*0.2 7 6.5*0.5 8.5*0.2 8 6.7*0.5 13.40.4	
ر 0 1	θ ₃ + Hθ ₂ - Hθ + 2θ ₂ +*NASA (1977) eval. Simonaitis, Heicklen (1973b) DeMore, Tschulkow-Roux (1974) Lloyd (1974) review Baulch, et al (1976) review	200-300 225-398 273-32 200-500	7.3 x 10 ⁻¹⁴ exp(-1275/T) k/(k _{ref}) ^{0.5} = 1.9 x 10 ⁻⁸ exp(-1000/T) k/(k _{ref}) ^{0.5} = 1.1 x 10 ⁻⁷ exp(-1550±550/T) 1.7 x 10 ⁻¹³ exp(-1400/T) 1.5 x 10 ⁻¹³ (a) k _{ref} = k(H ^Q _Q + H ^Q _Q + H _Q ^Q + H _Q or these studies and is based on k _{ref} value given in this table.	F

	keaction/kererce	Temp.	Reaction Rate Constant	
No.	* Preferred Value* NASA (1977) eval	Range/K	k/cm ³ molecule ¹ s ¹	Reliability of log k
7.27	63 + S6 + 62 + S62			
	Schoffeld (1973) review	223~303	2.5 x 10-12 exp(-1050/T)	#0*
	Baulch et al (1976) review		no recommendation	
7,28	63 + S62 + S63 + 62			
	Daubendiek, Calvert (1974)	300	×	
	Davis, Prusazcyk, Dwyer, Kim (1974)	300	€	
7,32	63 * H2S → products			
	Glavas, Toby (1975)	298-343	7 x 10-14 exp(-3400/T)	40.4
	Becker, Inocencio, Schurath (1975)	300	< 2 x 10 20	
7,35	63 + c1 → c16 + 62			
	+#Watson (1977) review	205-298	$2.7 \times 10^{-11} \exp(-257/T)$	±0.12 at 230K
	Clyne, Nip (1976)	221-629	5.18 x 10-11 exp(-418/T)	
	Kurylo, Braun (1976)	213-298		
	Watson, et al (1976)	220-350	×	
	Zahniser, et al (1976)	210-360	2.17 x 10 ⁻¹³ exp(-171/T)	
7,35Br	63 + Br → Br6 + 62			
	+*Leu, DeMore (1977)	224-422	3.34 x 10 ⁻¹¹ exp(-978/T)	±0.2 at 230K
7,36	6, + Cl6 + 6Cl6 + 6, (a)			
	. → Clθθ + θ ₂ (b)			
	+*NASA (1977) eval	200-300	$k_{\rm h} = 1 \times 10^{-12} \exp(-4000/T)$	+0.6, -2.0 at 230K (a)
			k, = 1 x 10 ⁻¹² exp(-4000/T)	
	Watson (1977) review	008	۸ × ۱۵ • ۱۵	
				ilts of Lin and
			equal to unity.	
7,36Br	63 * Br6 → products			
	+*Clyne, Cruse (1970)	293	K < 1 × 10-14	upper limit only
7,45	63 + C6 + C62 + 62		;	
	Arin, Warneck (1972)	296	<4 x 10=25	
7,48	03 + CH20 → products			
	slavsky, Heicklen	300	42 × 10 24	#0.3 upper limit
7,49	$\theta_3 + CH_3 + CH_3\theta + \theta_2$ (a) + CH ₂ $\theta + H\theta_2$ (b)			
	Simonaitis, Reicklen (1975)	221=298	(ka + kb)/kref = 12 exp(=525/T)	
			k_{ref} is 2nd order high press for $CH_3 + \theta_2(+M) + CH_3\theta_2(+$	ure limit M)
7,51	63 + CH362 → products		ı	
	Simonaitis, Heicklen (1975)	300	<2.4 x 10=17	
7,54	e ₃ + ch ₃ ene →			
	Hastie, et al (1976)	258-325	6.8 x 10-13 exp(-5315/T)	
7,56	θ ₃ + CH ₄ → products			
			F .	

62 9.0 x 10 ⁻¹⁵ exp(-2560/T) 2.7 x 10 ⁻¹⁸ exp(-2560/T) 1.5 ± 0.15 x 10 ⁻¹⁸ 1.6 ± 0.2 x 10 ⁻¹⁸ 1.7 ± 0.1 x 10 ⁻¹⁸ 1.9 ± 0.1 x 10 ⁻¹⁸ 1.7 ± 0.1 x 10 ⁻¹⁸ 1.7 ± 0.1 x 10 ⁻¹⁸ 60 1.3 ± 0.1 x 10 ⁻¹⁸ 61 1.25 ± 0.1 x 10 ⁻¹⁸ 62 6.1 x 10 ⁻¹⁵ exp(-1900/T) 1.30 x 10 ⁻¹⁵ exp(-1900/T) 1.30 x 10 ⁻¹⁵ exp(-1900/T) 1.30 x 10 ⁻¹⁵ exp(-1970 ± 100/T) 1.30 x 10 ⁻¹⁵ exp(-1970 ± 100/T) 63 x 10 ⁻¹⁵ exp(-2750/T) 63 2.9 ± 0.2 x 10 ⁻¹⁵ exp(-1686 ± 1.23 x 10 ⁻¹⁵ 63 2.9 ± 0.2 x 10 ⁻¹⁵ exp(-1686 ± 1.6 x 10 ⁻¹⁵ exp(-2900/T) 63 2.9 ± 0.2 x 10 ⁻¹⁵ exp(-2680/T) 64 x 10 ⁻¹³ exp(-2680/T) 65 5.4 x 10 ⁻¹³ exp(-2680/T) 66 8.3 x 10 ⁻³⁴ exp(+500/T)cm ⁶ molec 67 8.3 x 10 ⁻³⁴ exp(+500/T)cm ⁶ molec 68 8.3 x 10 ⁻³⁴ exp(+500/T)cm ⁶ molec 69 8.3 x 10 ⁻³⁴ exp(+500/T)cm ⁶ molec	remp.	
* C ₂ H ₄ - products rron, Hule (1974) erjian, et al (1974) review gore (1969) sore (1969) sore (1969) sore (1969) sore (1969) sore (1969) cron, Hule (1974) cron, Hule (1974) cron, Hule (1974) sore (1969) sore (1969) cron, Hule (1974) sore (1969) cron, Hule (1974) sore (1969) sore (1974) sore (1975) sore (1975) sore (1975) sore (1975) sore (1976) sore (1975) sore (1976) sore	.ge/K k/cm ³ molecule ¹ s ¹	. A
rron, Hule (1974) erjian, et al (1974) erjian, et al (1974) duan, et al (1973) duan, et al (1973) fore (1969) er, Wu, Niki (1974) er, Herron (1975) er, Wu, Niki (1974) er, Herron (1975) er, Herron (1976) er, Herron (1975) er, Herron (1975) er, Herron (1975) er, Herron (1975) er, Herron (1976) er, Her		
erjian, et al (1974) review 300 ore (1969) las (1974) las (1974) ser, Wu, Niki (1974) ser, Schurath, Seltz (1974) ser, Wu, Niki (1976) ser, Schurath, Seltz (1974) ser, Schu	9.0 x 10-15	1.04
dmen, et al (1973) dmen, et al (1973) dmen, et al (1974) is (1974) cref (1974) cref (1974) cref (1976)		
dman, et al (1973) is (1974) ac, Schurath, Seltz (1974) c c c de - Schurath, Seltz (1974) c c d (1964) rron, Hule (1974) rron, Hule (1974) rron, Hule (1974) c c d (1969) rron, Hule (1974) rron, Hule (1975) releance churene - products releance clock - company		
150 1974 150		
ker, Schurath, Seitz (1974) ar, Wu, Niki (1976) c 1969) c 216 - products rrion, Hule (1974) c 216 - products rrion, Hule (1974) c 216 - products c 1969) c 1969) c 216 - products c 1969) c 216 - products c 1969) c 1969 c 216 - products c 1969) c 216 - products c 217 - products c 217 - products c 218 - products c 21		
### Wet al (1976) ** C_3H6 - products ** C_3H6 - products ** Fron, Huie (1974) ** Fron, Huie (1975) ** Fron, Huie (1976) ** Fron, Huie (1977) ** Fr		100/T)
y, et al (1976) • C3H ₆ → products rron, Huie (1974) erjian et al (1974) erjian et al (1974) rron, Huie (1974) erjian et al (1974) erjian et al (1974) er, Wu, Niki (1974) e, Herron (1975) e, Herron (1976) e, Herron		
* C ₃ H ₆ + products rron, Huie (1974) erjian et al (1974) review gore (1969) lore (1974) lore (1975) lore (1976) lor		
rron, Huie (1974) erjian et al (1974) ore (1969) dman, et al (1974) dman, et al (1973) dman, et al (1973) at, Wu, Niki (1974) e, Herron (1975) e, He		
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ore (1969) ter (1969) ter, Wu, Niki (1974) ter, Wu, Niki (1974) ter, Wu, Niki (1975) ter, Wu, Niki (1975) ter, Wu, Niki (1974) ter, Wu, Niki (1975) ter, Wu, Niki (1974) ter, Wu, Niki (1975) ter, Wu, Niki (1974) terns=2=butene → products ter, Wu, Niki (1974) terns=2=c2cl2H2 → products terns=c2cl2H2 → products ulch, et al (1973) review ulch, et al (1973) review where		
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### Schurath, Seltz (1974) 298 11.31 ### Schurath, Seltz (1974) 298 11.31 ### allene = products	•	
### ##################################	360 - 21 - 10-14	(1)00
* allene + products * Joby (1975) * 1 -butene + products * i -butene + products * i -butene + products * cis=2=butene + products * cis=2=butene + products * cis=2=butene + products * cis=2=butene + products * trans=2=butene + products * Toby (1975) * cis=C2Cl2H2 + products * cis=C2Cl2H2 + products * trans=C2Cl2H2 + prod	1.40 × 10-17	
+ allene - products y, Toby (1975) 1.6 1 -butene - products e, Herron (1975) c.is=2=butene - products c.is=2=butene - products e, Herron (1975) ar, Wu, Niki (1974) trans=2=butene - products e, Herron (1975) e, Herron (1975) trans=2=butene - products e, Herron (1975) trans=2=butene - products e, Herron (1975) trans=2=butene - products y, Toby (1975) trans=2=butene - products y, Toby (1975) trans=C2Cl2H2 - products e et al (1976) trans=C2Cl2H2 - products where ulch, et al (1973) review ulch, et al (1973) review where	(a) Includes 300 K point	t of Hanst et al (1958).
## Toby (1975) * 1-butene → products * 1.butene → products * 4. Herron (1975) * a., Wu, Niki (1974) * cis=2-butene → products * p. Herron (1975) * trans=2-butene → products * p. Herron (1975) * trans=2-butene → products * p. Herron (1975) * trans=2-butene → products * p. Toby (1975) * trans=2-butene → products * Toby (1975) * trans=C2Cl2H2 → products * trans=C4 (1976) * trans=		
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e, Herron (1975) er, Herron (1975) ar, Wu, Niki (1974) e, Herron (1975) e, Herron (1976) e, Herr		ered. Data in
e, Herron (1975) e, Terron (1975) e, Cis=2-butene - products e, Herron (1975) e, Herron (1974) e, Herron (1975) e, Herron (1975) e, Herron (1975) e, Herron (1975) e, Trans=2-butene - products f, Toby (1975) f trans=C ₂ Cl ₂ H ₂ - products e tal (1976) f trans=C ₂ Cl ₂ H ₂ - products herron (1976) f trans=C ₂ Cl ₂ H ₂ - products and etal (1976) f trans=C ₂ Cl ₂ H ₂ - products herron (1976) f trans=C ₂ Cl ₂ H ₂ - products from etal (1976) f trans=C ₂ Cl ₂ H ₂ - products from etal (1976) f trans=C ₂ Cl ₂ H ₂ - products from etal (1976) f trans=C ₂ Cl ₂ H ₂ - products from etal (1976) f trans=C ₂ Cl ₂ H ₂ - products from etal (1976) f trans=C ₂ Cl ₂ H ₂ - products from etal (1973) review from f tal (1973) review from f tal (1973) review f trans=C ₂ Cl ₂ H ₂ - products	10by and 10by (19/4a)	(p+
e, Herron (1975) er, Herron (1975) er, Wu, Niki (1974) e, Herron (1975) e, Herron (1976) e, Herro		
e, Herron (1974) e, Herron (1975) for the et al (1974) for the et al (1975) for the et al (1973) review else cal (1975) for the et al (1973) review	363	.686 * 20/T)
e, Herron (1975) er. Herron (1975) ar. Wu, Niki (1974) er. Herron (1975) e. Herron (1975) e. Herron (1975) e. Herron (1976) f. 1,3=butadiene products gr. Wu, Niki (1974) gr. Toby (1975) refer, Schurath, Seitz (1974) tels-C2Cl2H2 products trans-C2Cl2H2 products frans-C2Cl2H2 products are et al (1976) f. trans-C2Cl2H2 products are et al (1976) are et al (1976) f. trans-C2Cl2H2 products are et al (1976) are et al (1976) h. W. M.		
e, Herron (1975) 225-363 3.1 4 trans=2=butene - products e, Herron (1975) 225-363 6.0 ar, Wu, Niki (1974) 298 273-343 1 x ker, Schurath, Seltz (1974) 296 3,7 4 tls=C2Cl2H2 - products me et al (1976) 4 trans=C2Cl2H2 - products ne et al (1976) N * M * N2 * M where where ulch, et al (1973) review 100-600 m ** where		
ar, Wu, Niki (1974) • trans=2=butene → products •, Herron (1975) ar, Wu, Niki (1974) • 1,3=butadiene → products • 1,3=butadiene → products y, Toby (1975) • cis=C2Cl2H2 → products ame et al (1976) • trans=C2Cl2H2 → products • trans=C2Cl2H2 → pr	3.1 ± 0.7 x 10-15	
+ trans=2=butene - products e, Herron (1975) ar, Wu, Niki (1974) 1,3=butadiene - products y, Toby (1975) cis=C2Cl2H2 - products trans=C2Cl2H2 - products trans=C2Cl2H2 - products wher al (1976) 1 x 296 3,7 ulch, et al (1973) review 100-600 8,3 where	1.61	
e, Herron (1975) 225=363 4.1,3=butadiene → products 7. Toby (1975) 273=343 1 x 2.66 2.56 2.66 2.73=343 1 x 2.67 2.66 2.75 2.66 3.7 4 trans=C ₂ Cl ₂ H ₂ → products 4 trans=C ₂ Cl ₂ H ₂ → products 5.4 5.4 5.4 6.60 8.3 9.7 100=600 8.3 100=600 8.3		
products 273-343 1 x tz (1974) 280-360 5.4 oducts products 296 3.7 products 296 2.5 review 100-600 8.3 where	6.0 * 1.0 x 10-15	051 ± 43/T)
products 273-343 1 x tz (1974) 280-360 5.4 oducts 296 3.7 products 296 2.5 review 100-600 8.3 When		
tz (1974) 280-360 5.4 oducts 296 3.7 products 296 3.7 review 100-600 8.3 When		
tz (1974) 280-360 5.4 oducts 296 3.7 products 296 2.5 review 100-600 8.3 wher	.	₽. • O #
oducts 296 3.7 products 296 2.5 review 100-600 8.3 where	5.4 × 10-14	
296 3.7 products 296 2.5 review 100-600 8.3 where		
products 296 2.5 2.5 review 100-600 8.3 When	7.5	
296 2.5 review 100-600 8.3		
review 100=600 8.3 K = M = When	c	
review 100-600 8.3 M = M = Wher	0	
where = d[N]/d+ = 2k[N] ² [y]	m (*
	m = N2 where = d[N]/d+ = 2k[N] ² [w]	(4,200K)
Taylor (1975) review 2000-10000 7.6 x 10-32 T-1/2 M = N2	7.6 x 10 32 T 1/2 M =	, co

December 1977				
No.	Reaction/Reference * " Preferred Value + " NASA (1977) eval	Temp. Range/K	Reaction Rate Constant k/cm ³ molecule ¹ s ³ 1	Notes and Reliability of log k
0.0	$(T) \Theta + Z + W + W$		3.0 x 10=32 T=1/2 M = 0 ₂ , 0, NO 6.5 x 10=27 T=3/2 M = N	
7 4 6	+*Clyne, #CDermid (1975)	258=670	$k_{\phi} = 8.2 \times 10^{-11} \exp(-410/T)$	#0.2 at 230K
	Baulch, et al (1973) review	300=2000	= 2.7 x 10=11	±0.1 (a)
		2000-2000	$k_{\rm F}$ = 1.3 x 10 ⁻¹⁰ exp(=39000/T) (a) Uncertainty increases to ±0.3 for T> 2000, $k_{\rm f}$ based on 300 K data and $k_{\rm f}$ (T> 2000),	±0.4 2000.
8,10	Taylor (1975) review $N + N\theta_2 - N_2\theta + \theta$	2000-10000	Kg = 2.7 × 10=33	
	+*NASA (1977) eval. Clyne, McDermid (1975)	200-300	2 x 10 ⁻¹¹ exp(-80c/T) 1.4 x 10 ⁻¹²	#0.3 at 230K (a,b)
8.19	# • • • • • • • • • • • • • • • • • • •		 (a) Accepts room temp, result of Clyne * "A factor" chosen; Eact derived (b) Believed to be sole reaction channel 	McDermld
	*Baulch, et al (1973) review	300	5.3 x 10 ⁻¹¹ (a) Based on $k/k(\Theta + H\Theta \rightarrow \Theta_2 + H) = 1.4$	#0,3 (a)
8,27	N + SØ + products		u	
	Baulch, et al (1976) review		no recommendation	
8,29				
0. 1.	Baulch, et al (1976) review		no recommendation	
	Watson (1977) review	298	k < 6 x 10=13	preliminary value
9, hv	NG + hv			
	Hampson, et al (1973a) review		mmended values of oscillator streng which absorption cross sections caved are given for β , γ , and ϵ bands mmended values of absorption cross	ths in he section
			No recommended quantum vield values.	
	*Bethke (1959)		decillator strength for 5 bands.	4.4
Ж. 6	$N\Theta + W \rightarrow N + \Theta + M$ Baulch, et al (1973) review	4200-6700	Insufficient data for a reliable recommendation	fation.
			Use, with caution: 6.6 x 10 ⁻⁴ T ^{-1.5} exp(-75.5 x 10 ³ /T) cm ³ molecule ⁻¹ s ⁻¹ (M - Ar, 6 ₂ , N ₂)	lecule 1s = 1
6*6	N6 + N6 + N + N62 Raulch o + A (1973) cowiew		KIM NO. N. C.J.KIAF.) 18 Forthwarmin Halmonton Commence to	
			NG + NG + N ₂ G + G	
6*6	NG + NG + N ₂ G + G		see reverse reaction	

No.	December 1977				
NG + NG + O2 + NG + NG		Reaction/Reference # = Preferred Value	Renge/K	Reaction Rate Constant k/cm ³ molecule ¹ s ⁻¹	
12 18 18 18 18 18 18 18	No.	+ * NASA (1977) eval		•	
### Schain, et al (1976) ### Schain, et al (1973) review ### Schain, et al (1973) review ### Schain, et al (1973) review ### Schain, default, et al (1973) review #### Schain, default, et al (1973) review ###################################	9,9,4	$N\Theta + N\Theta + \Theta_2 + N\Theta_2 + N\Theta_2$ $N\Theta + N\Theta_2 + H_2\Theta = ^2 2HN\Theta_2 (f)$ $2HN\Theta_2 + N\Theta + N\Theta_2 + H_2\Theta (f)$		62 + NA + NB + NB +	
Manpson, et al (1973) review 300 1.9 ± 0.41 7.0 = 11		*Chan, et al (1976)	296	× 10 0 0 0	
Graham, Johnston (1978) 300	111	(1973)	000	Kr = 9.5 x 10 - cm molecule 's . Reviewed earlier work, probably hetero	snoəuəs
Johnston (1966) review NG + NH - products Homerston (1966) review Homerston (1966) review NG + NH - products Homerston (1976) Socional et al (1976) NG + NH ₂ - N ₂ + H ₂ ⁶ *** Hability (1976) Socional et al (1975) Socional et al (1973) S		Graham, Johnston (1978) Baulch, et al (1973) review	300	± 0.4) ×	±0.7 estimated
Hansen, et al (1976) 300 4.7 x 10 ⁻¹¹ 1500 My + 6 + H identified as products of mejor r MuVibill, Phillips (1975) 300 3.8 x 10 ⁻¹¹ 1500 My + 6 + H identified as products of mejor r Ned + Mig + Mg + Mg + Mg + Mg + Mg + Mg + M		Johnston (1966) review	300	effect is	
Wulvhill, Phillips (1975) Wo + NH ₂ - N ₂ + H ₂ G* Wo + NH ₂ - N ₂ + H ₂ G* Hancock, et al (1975) Lesclaux, at al (1975) Gondon, et al (1971) Ondon, et al (1973) Wo + H + M + HNG + M This survey Atkinson, Cvetanovic (1973) Atkinson, C	9,15	NØ • NH • products Hansen, et al (1976) Gordon, et al (1971)	0 00 m	x 10 11 11 11 11 11 11 11 11 11 11 11 11	
## ## ## ## ## ## ## ## ## ## ## ## ##	V	=	1500	6 * H identified as products of	
Genring, et al (1973) Gordon, et al (1971) M *This survey NG * HG + M + HNG * M *This survey Naulch, et al (1973) review NG * HG(*M) - HNG_(*M) Hampson, et al (1973) review NG * HG(*M) - HNG_(*M) Hampson, et al (1973) review S100000000000000000000000000000000000		#Hancock, et al (1975) Lesclaux, et al (1975)	8 00 8 00	x 10-11 x 10-11 T-1.25	
#This survey Baulch, et al (1973) review Atkinson, Cvetanovic (1973) Allen, Moortgat (1973) Allen, Arr Allen, Moortgat (1973) Allen, Arr Arr Allen, Arr Allen, Arr Arr Arr Allen, Arr Arr Arr Arr Arr Arr Arr Arr	9.18M	Gehring, et al (1973) Gordon, et al (1971) NØ + H + M → HNØ + M	300	8 x 10"12 2.7 x 10"1	٠.04
Allen, Moortgat (1973) Allen, Moortgat (1973) Allen, Moortgat (1973) Allen, Moortgat (1973) I 80-300 E x 10 ⁻³² exp(+300/T), M = Ar I 1973) review Raulch, et al (1973) review 298-633 E (40,6) x 10 ⁻³² exp(-15,1 x 10 ² /T) Baulch, et al (1973) review 298-633 E (40,6) x 10 ⁻³² exp(-16,1) x 10 ² /T) Baulch, et al (1973) review 298-633 E (40,6) x 10 ⁻³² exp(-16,1) x 10 ² /T) And order 10 ² /T) And order 10 ² /T) And order 10 ² /T) Baulch, et al (1973) review 298-633 E (40,6) x 10 ⁻³² E (40,7) for E (40,7		4	230-400	x 10 ⁻³² exp(300/T) x 10 ⁻³² exp(300/T)	C
Baulch, et al (1973) review 298-633 5.2 x 10 ⁻¹² exp(-15.1 x 10 ² /T) hased on k = 5.8 x 10 ⁻¹⁰ exp(-740/T) for reverse reaction NØ + HØ(+M) → HNØ ₂ (+M) Hampson, et al (1973a) review 217 22 25 26 8.9 x 10 ⁻¹² Abs. value 217 22 26 8.9 x 10 ⁻¹² Abs. value 227 24 x 10 ⁻¹² Abs. value 227 25 26 8.9 x 10 ⁻¹³ at difference 237 25 35 35 4.8 x 10 ⁻¹³ reliab 237 25 4.8 x 10 ⁻¹³ at difference 257 26 8.9 x 10 ⁻¹³ at difference 257 27 39 2.5 x 10 ⁻³² exp(+1110/T) cm ⁶ molecule ⁻² s ⁻¹ M= 10.0 t 10.0	91.6	<u> </u>	180=300	±0.6) x 10=33 10=32 exp(+300	E L
NØ + HØ(-M) - HNØ ₂ (-M) Hampson, et al (1973a) review 217 220 222 225 226 8.9 x 10 ⁻¹² Abs. 227 227 230 227 24.8 x 10 ⁻¹³ at 227 25 25 4.8 x 10 ⁻¹³ at 237 251 40 1.1 x 10 ⁻¹³ 255 Baulch, et al (1973) review 273-395 2.2 x 10 ⁻³² exp(+1110/T) cm ⁶ molecule ⁻² (3rd order low pressure limit)		į.	298=633	x 10=12 exp(=15.1 x 1 d on k = 5.8 x 10=10 rse reaction corrected expression	
217 20 1.5 x 10 12 ADS. 222 22 25 8.9 x 10 13 at 227 35 25 4.8 x 10 13 at 237 35 2.6 x 10 13 265 45 273-395 2.2 x 10 -32 exp(+1110/T) cm6molecule=6 (3rd order low pressure limit)	M91.6		1	ation/km k(T,M)	3
237 35 2.6 x 10 13 251 40 1.1 x 10 13 265 45 5.9 x 10 14 273-395 2.2 x 10 32 exp(+1110/T) cm6molecule 6 (3rd order low pressure limit)			217 222 222		Relative value of different altitudes
251 40 1.1 x 10 7 265 45 45 5.9 x 10 14 273-395 2.2 x 10 32 exp(*1110/T) cm^molecule 2 (3rd order low pressure limit)			237	9.	
273-395 2.2 x 10"32 exp(+1110/T) cm ⁶ molecule"? (3rd order low pressure limit)			251 265	1.1 X 10 1 C	
		Baulch, et al (1973) review	273-395	x 10"32 exp(+1110/T) cm ⁶ molecule"? order low pressure limit)	s"1 M"He #0.2 at 300K inc. to #0.3 at 395K

December 1977	1977			
	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and
No.	+ = NASA (1977) eval	wall god	V (TH III)	log k
		300	2 x 10°12 cm³molecule";s"1	F 0 4
			high pressure limit)	,
	Anderson, et al (1974)	295, 439	5.8 ± 1.2 x 10 ⁻³¹ x (295/T)*2.4 cm molecule 2s-1	F
			Relative efficiencies: N ₂ (1.0), Ar(0.58), He(0.57)	0.57)
	Howard, Evenson (1974)	296		
			low pressure limit)	
			Relative efficiencies: N ₂ (1.0), Ar(0.55), He(0.51)	0.51)
	Cox (1974a)	294	10 # 7	
			₩.	(a)
			ate constant, [M] =	
			+ 62; kref = 3 x 10 13, this	survey
	Harris, Wayne (1975)	300	ŭ	
			15 ± 5 x 10"31, N = N2	
		L C	(3rd order low pressure limits)	
	cordon, autac (1973)	ս Մ	/.5 x U.3 X 10 cm motecute s	
			stan	
	Atkinson, Hansen, Pitts (1975a)	298	* 0.5 x 10"13	(p)
			also data for M -	
	Cox, Derwent, Holt (1976)	298	1.17 x 10 1 M = 1 atm N2 + 02	(°)
			9 + H2)	
	dverend, et al (1976)	295	$0.956 \pm 0.05 \times 10^{-12} M = 25 \text{ torr } N_2$	
			M = 770	
	Sie, et al (1976b)	298	k/kref = 16.1 at 95 torr and = 22 at	
			768 torr total pressure, m	
0	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		H ₂ where ref rxn is HΘ + CΘ → CΘ ₂ + H	
02.6	NO + HO2 - NO2 + HO			
	+*Howard, Evenson (1977)	296	(8.1 ± 1.5) x 10"12	±0.4 at 230K
	Hack, et al (1975)	298-670	×	
	Simonaitis, Heicklen (1978)	245=328	6.4 x 10 cxp((a)
			(a) refrxn: $2H\theta_2 \rightarrow H_2\theta_2 + \theta_2$	
	Cox, Derwent (1975)	296	2	
	Payne, Stief, Davis (1973)	300	a x 10 1 a	#0°2
		1350-1700	7.5 x 10=12	±0.5
9,20M	$N\Theta + B\Theta_2(+M) + BN\Theta_3(+M)$			
	Cox, Derwent (1975)	296	1.4 x 10-13 at 1 atm N2 + 02	
9,21	Simonaitis, Heicklen (1976a) NØ + H, + HNØ + H	296	A N N 10=15	
	Baulch, et al (1973) review	2000	5.3 x 10°18 cm ³ molecule 1s-1	±0.5 (a)
			No data.	

No.	* * Preferred Value + * NASA (1977) eval	Kange/k	K/cm_molecule .s	Reliability of log k
9,22	NG + H ₂ G → HNG + HG			
	Baulch, et al (1973) review	2000	4 x 10=18 (a) No data. Value based on reverse rate. (corrected)	±0.2 (a)
9,23	NG + H202 - HG + HN02			
	*Hampson, et al (1973) review	300	× 5 × 10 = 20 × 2 × 10 = 20	
		300	< 5 x 10-20	
9,35M	NØ + Cl + M + ClNØ + M +*NASA (1977) eval	200=300	1.7 x 10 $^{-3}$ 2exp(+530/T M = N ₂ (a) see Watson (1977) review	±0.6 at 230K (a)
9,36	NØ + ClØ - NØ2 + Cl			
	+*NASA (1977) eval	200-300	1.0 x 10-11 exp(200 ± 100/T)	±0.3 at 230K
	Watson (1977) review	220-298	8 x 10 12 exp(250/T)	F • O #
	canniser, nautuan (1977)	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(8)
9,36Br	NG + Br6 - NG ₂ + Br			
	+*NASA (1977) eval	200-300	2.1 x 10=11	±0.4 at 230K
	Clyne, Watson (1975)	298	2.2 x 10 ⁻¹¹	±0.1
9,37	Ne + ecle → Ne ₂ + cle			
	+*NASA (1977) eval	200=300	$2.5 \times 10^{-12} \exp(-600/T)$	±0.6 at 230K (a)
	Bemand, Clyne, Watson (1973)	300	Α.	
			(a) Based on room temp, value of Bemand, Clyne, Watson; temp dependence estimated	100
M64.6	NØ + CH ₂ (+M) + CH ₂ NØ (+M)			
	Laufer, Bass (1975)	298	10 ¹¹ x k P(N.)/torr	(a)
			, e	
		o c	1.1	
	was des Bergh Callean (1971)	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4 × 10 = 1	(a)
)	Val	
				73).
9,50	NØ + CH₂Ø → • •		CH, 6	
9,51	0 0 0			
	*Demerjian, et al (1974) review	300	$k_c = 3.3 \times 10^{-12} \exp(-500/T)$	estimate
	Cox, et al (1976)	298	Kc - 1.2 x 10 12	lower limit (a)
		900	Possetion manage and mained the transfer of the part o	(0)
	Simonaitis, Heicklen (1974)	298 298	k_/k = 0.80 ± 0.15	(c)
			(K = K ₂ + K ₃ + K ₂)	

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December 1977	1977				
	Reaction/Reference	Temp.	Reaction	Reaction Rate Constant	
No.	* = Preferred Value + = NASA (1977) eval	Range/K	k/cm ² mo	lecule 's '	Reliability of log k
10, hv	NG ₂ + hv -> NG + G				
	*Bayes (1974)		54		
			00	1.0 - 0.0008(A - 275)	(a)
			004	0.76 # 0.04	
			4 05	0.37 \$ 0.02	
				0.14 ± 0.03	
			o	analysis of data in Jones	Jones and Rayes (1973)
	*Bass, Ledford, Laufer (1976)	235-298	Extinction coef	coefficient values tabulated	lated
			for \ = 185-410	for A = 185-410nm at 0.125nm intervals.	vals.
			Also gives valu	gives values for N284	
10, M	NG + M + NG + G + M		see reverse reaction	ction	
10,10					
•	Baulch, et al (1973) review		No recommendation	uo	
01.01			(
	Baulch, et al (1973) review	000-5000	3.3 x 10 = 12 exp(= 13540/T)		±0.15 (500-1000K)
			k1[N62] = -(1/		increasing to 0.3 at 2000K
10,10M	NG + NG + M - * N204 + M (f)				
	Baulch, et al (1973) review	250-350	kf = 3.0 x 10 3 (a) corrected	3.0 x 10 35 exp(1040/T) cm molecule 2 s 1 corrected expression; k f " k k eq	olecule ² s ¹ M = N ₂ *0.15(a) * krkeq
	Denilop 64 61 (1073) conto	000000		E/ 0 3 3 5 7 1 1 1	x = x #0.15
	Dacielly et al (1973) Feelew	000	.	(1/occc_)dxa	ر. د
	Schoffeld (1973) review	250-350	k_ = 3.3 x 10"7	x 10-7 exp(-5540/T)	M = N ₂ ±0.15
10,11	$N\theta_2 + N\theta_3 + N\theta_2 + \theta_2 + N\theta (f)$ $\theta_2 + N\theta + N\theta_2 + N\theta_2 + N\theta_3 (f)$				
	*Baulch, et al (1973) review	300-850	kf = 2.3 x 10 1	2.3 x 10-13 exp(-1000/T)	±0.4 (a)
		300=200	- Ke/Ken	- 8 x 10-41exp(400/T)cm ⁶ molecule-2s-1	n ⁶ molecule ² s ⁻¹ ±0.4
	Graham, Johnston (1978)	338-396		2.5 x 10-14 exp(-1230/T)	
			(a) Based on N2	- NO NO	* M and
10.11%	(A+) FE N F (A+) FEN + FEN		2NG2 - 2NG + G2	•	
	This survey		Elevation/km		(A) Bol
				cm3molecule s=1	
		217	ຂ		18.60
		217	20		18.27
		222	25	x 10 13	17.53
		227	30	x 10 15	17.58
		237	м	X 10 13	17.26
		251	04	x 10=13	16.92
		265	4	7.1 × 10-14	16.60
10,11M	NG2 + NG3 + M - N265 + M (f)				
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	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and	
No.	+ - NASA (1977) eval				
		00£	kf = 3.8 x 10 12 cm 3molecule 1s 1	#0.4 (a)	
		300-340	(2d order high pressure limit) k, = 2.2 x 10 = 5 exp(-9700/T) cm molecule = 1s = 1	±0.3 (a)	
		273-300		#0.4 (a)	
	Graham, Johnston (1978)	298-329	(limiting first order expression) K = 1.2 x 10 = 2 exp(*11189/T)cm molecule = 1		
		273-300	1.48 x 10	(b)	
			k _r (M) = 1.24 x 10 ¹⁴ exp(-10317/T)s ⁻¹	(c)	
			(a) $K_{\underline{f}} = K_{\underline{G}} K_{F}$, $M = N_{\underline{G}} F_{\underline{G}} + NG$ (b) 2d order rate const at 1 atm		
			(c) 1st order rate const at 1 atm		
10,16	No ₂ * NB ₂ - products Javantv. et al (1975d)	006	(THY + EX) X * X		
10,17	NO + NH3 + NHO		. 2		
	Bedford, Thomas (1972)	615-660	6.7 x 10 ⁻¹² exp(-13900/T)		
10,18	N62 + H + H6 + N6				
	Wagner, et al (1976a)	243-461	7.1 x 10-10 exp(-505 * 84/T)	#0.1	
	Clyne, Monkhouse (1977)	298-653	4.80 x 10 10 exp(-400 ± 70/T)	*0.1	
		298	1.13 ± 0.22 x 10"10		
10,19M 26, M	NO ₂ + HG + M + HNO ₃ + M (f) HNO ₃ + M + HG + NO ₅ + M (r)				
	+*NASA (1977) eval	200-350	$\log_{10}(k_f) = -AT/(B + T) - 0.5 \log_{10}(T/280)$		
			A = A, + A ₂ Z + A ₂ Z + A _A Z ³		
			* B.Z * B.Z ²		
			A. = 31.62273 B. = -327.372		
			= -0.258304 B2 =		
			= -0.0889287 B ₃ =		
			A4 " 2.520173 x 10"3		
			where Z = $log_{10}[N_2]$ and is applicable only for the ranges	the ranges	
			200 47/K 350 and 16.3 log10 ([N2]/molecule .cm 3) 15.5, with	<15.5, with	
			an estimated reliability in log K of #0.10 (reliability	iability	
			efficient then nitrogen as a third body: i.e		
			K for (M = Air) = 0.94 k for M = N.		
			For normal tropospheric conditions of 1 atm air		
			value of k _f = 1.1 x 10 11		
	Anastasi, Smith (1976)	296	k2 = 2.6 x 10 = 30 M = N2		
			Rel. Efficiencies: N ₂ (1.0), He(0.34), Ar(0.42),		
		220-550	n = -2.5 for temp dependence of form In, M = N2	Q.	
			values given for bimolecular rate constant over		

No.	1977 Reaction/Reference * Preferred Value + * NASA (1977) eval Baulch, et al (1973) review	Temp. Range/K 273-400 800-1200	Reaction Rate Constant	Notes and Reliability of Log k
	Anderson, et al. (1974) Howard, Evenson (1974) Gordon, Mulac (1975)	300 290 8450 4435	Ar 10=12 c order high p N N 2 ative efficie = 2.9 ± 0.4 x = 5.3 x 10=12	2 8 1 8 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
	ts (1	د 5 9 6 8		
0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NO ₂ + HO ₂ + M → HO ₂ NO ₂ + M + WASA (1977) eval Simonaitis, Heicklen (1978) Howard (1977)	2 2 8 0 44 8 0 0 9 9 9 9 9	tively ned urk(H62 k(H92 M - 70 ls ned is ned eff:	(a) (b)
10,28 10,35M	Cox, Derwent (1975) $NG_2 + SG_2 - SG_3 + NG$ Davis (1974) $NG_2 + Cl + M + NG_2Cl + M$	3 5 8 3 0 0	$k[M] = 1.2 \times 10^{-1.3}$ for [M] = 1 atm product probably $H\sigma_2N\sigma_2$ not $H\sigma N\sigma + \sigma_2$ as assumed by $k < 2 \times 10^{-24}$	by authors
10,36M	SA SA	2500-356	7.2 x 10 ⁻³¹ cm ⁶ molecule ⁻² s ⁻¹ 3.3 x 10 ⁻²³ I ^{-3.34} 1 + 8.7 x 10 ⁻⁹ T ^{-0.6} [M] ^{0.5} (a) Expression developed by Zahniser, Chang, Kaufman (1977) (4.40 ± 0.66) x 10 ⁻³³ exp(1087/T) M = N ₂	at 230K (a)

N_2 * H0 \rightarrow N_2 0 * H *Baulch, et al (1973) review N_2 0 * hv \rightarrow products Johnston, Selwyn (1975) Selwyn, et al (1977)
Chang, Kaufman (1977) Bierman, et al (1976) Atkinson, Perry, Pitts (1976) Gordon, Mulac (1975) N ₂ G * ClG + products **NASA (1977) eval **NASA (1977) eval Milks, Matula (1973) Milks, Matula (1973) Molina (1977) review

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	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and	
	* * Preferred Value	Range/K	k/cm3molecule 1s 1	Reliability of	
No.	+ * NASA (1977) eval			log k	
	Murphy (1969)		0.5 x β(-N ₂ θ ₅) = β(θ) = 0.31 Meas, by Holmes, Daniels (193	Ø(θ) = 0.31 λ = 280 nm Daniels (1934) are consistent	
	Hampson, et al (1973a) review		of photoch		
	Daubendiek, Calvert (1974)		e giving	coefficient	
¥ 4 1	CA+		VS A. 250 A/nm 350 Flovation/km		
E .	E 201		4 4 1 0 1 1 V III		
	*This survey	217	X 0.0	10-7	
		217	X 00 • 1	10	
		222	X 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 10 10 10 10 10 10 10 10 10 10 10 10 10	
		227	30 x 0.0 x	10	
		251	K 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	ν L	
		265	4 × 4 × 4 × 4 × 4 × 4 × 4 × 4 × 4 × 4 ×	ທີ່	
			trapolated from data	taken between 273 and 353 F.	
14, M	N265 + M + N02 + N03 + M N267 + H26 = 2HN03		see reverse reaction		
•	Harmon of 61 (1973) 10001000	000	•		
	•	000	× ۱ • ۱۰		
200	M P CA IN THE CALLED	0.47	۲ .		
0764	12°5 5°5 1 products		F C 1		
	Daubendiek, Calvert (1974)	300	4 X		
	Davis (1974)	300	K < 8 × 10 24		
16,18M	NH ₂ + H + M = NH ₃ + M				
	Baulch, et al (1973) review	2000=3000	1.2 x 10-33 exp(11200/T) cm ⁶ molecule ² s ⁻¹	nolecule 2s 1, M - Ar ±0.3 (a)	
			(a) k _f + K _{eg} k _r		
16,19	NH2 + H8 + NH3 + C		see reverse reaction		
12,01	NH2 + RH3 + H				
	Baulch, et al (1973) review	800	< 10 10 Kf = Keqkr	approximate	
16,22	NH2 + H26 + NH3 + H6				
17, M	M + H + CHN + W + HN				
	Baulch, et al (1973) review	2000=3000	k = 1.5 x 10 8 exp(-42400/T) (M	W = Ar) ±0.7 (a)	
			To be used	•	
17,18	$^{\rm NH}_3$ + H \rightarrow NH ₂ + H ₂				
17.10	Baulch, et al (1973) review	800	< 10=16	approximate	
	2 2 NO 10 END		0		
		228-472	10-1 exp(-800/T)	1,00	
	Perry, Atkinson, Pitts (1976a)	298-427	2.93 x 10 "-exp(=850 = 150/T		
		300	н	preliminary	
	Cox, Derwent, Holt (1975)	300	* 0.4) × 10		
	Hack, et al (1974)	298-669	# 0.8 XL		
	Stuhl (1973a)	298	R	# P P P P P P P P P P P P P P P P P P P	
	Kurylo (1973)	258	K 10	\$0°0\$	
	Gordon, Mulac (1975)	418	4.8 × 0.8 × 10⁻+∪		

	Donothon / Donot	1		4 4 4 4
° OZ	* = Preferred Value + = NASA (1977) eval	Range/K	K/cm3molecule 18 1 Re	Reliability of log k
17,36	NH3 · Cle · products			
	Walker (1972)	670	K < 5 x 10 ⁻¹⁶	(a)
170,18	N2H4 + H - H2 + N2H3		tal ha quoted by matson (1977) review.	
18,18M	Stief, Payne (1976) H + H + M - H ₂ + M (f) H + N - H + H + H + M - H ₂ + M (f)	228-400	$(9.87 \pm 1.17) \times 10^{-1}^{2} \exp(-1200 \pm 50/T)$	
E 64 J	Baulch, of al (1972) review	300	7 = A = 4 10=23 cm6molecule=2=1 N = H	0
		1700-5000	1.8 x 10 = 30 T = 1 M = Ar	M * 0 #
		000	Rel. efficiencies: H ₂ (1.0), Ar(0.25) -d[H]/dt = 2k[H] ² [M]	r 6
		0006-0062	K 3.7 X 10 - exp(=48300/1)cm molecule '8 ', H * Ar	5 ° 0 H
18,19 18,19M	H + HØ + H2 + Ø H + HØ + M => H2Ø + M (#)		see reverse reaction	
M 6 2 2			2 C C C C C C C C C C C C C C C C C C C	
	*Baulch, et al (1972) review	2000-8000	<pre>k_f = 6.1 x 10^{-c.T} cm^{omolecule ^{c.g.}, M = N₂ k_f = 5.8 x 10⁻⁹ exp(=52900/T) cm³molecule ^{1g=1} M = N₂}</pre>	E 60.4
	Zellner, Erler, Field (1977)	230=300	K _f = 4.3 x 10=25T=2.6 M = He Rel eff: He(1.0), Ar(1.5), N.(3.2)	
18,20 19,19 18,20 18,20	H + H ϕ_2 - H ϕ + H ϕ (1f) H ϕ + H ϕ - H + H ϕ_2 (1f) H + H ϕ_2 - H ₂ + ϕ_2 (2) H + H ϕ_2 - H ₂ ϕ + ϕ (3)			
	Baulch, et al (1972) review	290-800	$k_{1f} = 4.2 \times 10^{-10} \exp(-950/T)$	±0.3 (a)
			$k_{1r} = k_{1f}/K_{eq} = 2.0 \times 10^{-11} \text{ exp}(-20200/T)$	£0.3
		290~800	$k_2 = 4.2 \times 10^{-11} \text{ exp(-350/T)}$	40.4
			k2r = k2f/Keq = 9.1 x 10 ⁻¹¹ exp(~29100/T) k ₂ = no recommendation	*0.4
	Lloyd (1974) review	300-1000	kif and k2 - same as Baulch, et al	>±0.7 (a)
			k ₃ = 8.3 x 10 ⁻¹¹ exp(-500/T)	>40.5 (b)
	Moortgat, Allen (1973)	297	k1f " 8.3 x 10"12) (c)
			$k_2 = 1 \times 10^{-11}$) (c)
			$k_3 = 6.7 \times 10^{-12}$? (c)
			(a) Reaction 1 and rate ratios control values for	20
			(b) Temperature coefficient estimated. (c) Secondary reaction in H * G, * M systems, i	<u>*</u>
			of concentration vs. time plots.	

aber	December 1977	1		
	Reaction/Reference * Preferred Value * NASA (1977) eval	Temp. Range/K	Reaction Rate Constant k/cm ² molecule s = 1	Notes and Reliability of log k
18, 22	H + H ₂ C - H ₂ + HC Baulch, et al (1972) review	300-2500	1.5 x 10 ⁻¹⁰ exp(-10250/T)	±0.06 at 300K increasing to ±0.2 at high temp.
1 8 2 2 3	H + H ₂ θ ₂ + H ₂ + Hθ ₂ (a) + Klemm, Payne, Stief (1975) Gorse, Volman (1974) Hampson, et al (1973)	283-353 300 300-80	Ka + kb = 5.2 ± 2.0 x 10 ⁻¹² exp(-1400 Ka = 3.1 ± 0.8 x 10 ⁻¹⁵ Kb = 5.7 ± 1.4 x 10 ⁻¹⁵ Ka = 2.8 x 10 ⁻¹² exp(-1900/T) Kp no recommendation	* 140/T)
18,24	Meagher, Heicklen (1975) H + HNØ + H ₂ + NØ Hampson, et al (1973) review Baulch, et al (1973) review	298 211-703 2000 300	x 10=14 x 10=14 10=12 3 < k < 10=12	P P C
18,25 18,25 20,28 20,28 20,28	H + HN6 ₂ - products Hampson, et al (1973) review Baulch, et al (1973) review H + HN6 ₃ - products Hampson, et al (1973) review Chapman, Wayne (1973) review H + S6 ₁ + W + HS6 ₂ + W + HS6 ₃ + W + HS6 ₃ + W	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	No data No recommendation 1 x 10 ⁻¹³ 2 x 10 ⁻¹⁵ 10 ⁻¹³	approximate upper limit
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	st al (1976) H ₂ * S (f) H + HS (r)	1660-2120 298	1.4 x 10=32 k _f = 2.5 x 10=11 k _r = 2.2 x 10=25 (a) k _r = k _f /R _{eq}	#0.2 #0.2 #0.0 (a)
	Cupitt, Glass (1974) H + H ₂ S + H ₂ + HS Kurylo, Peterson, Braun (1971)	190-464	* 0.8 x 10-11 0-11 exp(860/T) ected by Baulch,	(a) et al (1976) review
18,34c	H + C6S - C6 + HS Baulch, et al (1976) review H + GCl6 - H6 + Cl6 *Watson (1977) review	300 298	2.2 x 10-14 5.7 * 1.2 x 10-11	∪ • 0 #

16,39	December 1977	1977			
# + NASA (1977) eval # + RC1 - Rg + CL Abbidse, ct al (1976) System (1976) System (1976) # + CC2 - RC1 + CL # + RC2 - RC1 + CL # + RC2 - RC1 + CL # + RC2 - RC1 + CL # + CC2 - RC1 + CL # + CC3 - RC			Temp.	Reaction Rate Constant	
H + HCl - Hg + Cl Species, cf al (1976a) Species, Class (1975) Species, Class (1976) Species, Class (1977) Sp	No.	NASA	4 /08	אירות שניהנינים ט	
Subsidiary et al (1976a) Subsidiary et al (1976b) Subsidiary et al (1976b) Subsidiary et al (1976b) Subsidiary et al (1976) Subsidiary et al (1977) Subsidiary et al (1972) review	18,39	+ HCl - H2 +			
# + CRG - #CL + RCL + NG # # + NG # +		Ambidge, et al (1976a)	298-521	×	
## CCC For 10 Fo		Spencer, Glass (1975)	295	×	
# + CL ₂ = MCH + CL ₃ # This survey # This surv	18,42	WALLE THE THE THE	4 1 11 11 11 11 11 11 11 11 11 11 11 11	- 40-11-00-6-4	
### Person of the property of	18,44	H + Cl ₂ - HCl + Cl	194 166 7	To explored of x	
Bennand, Clyne (1977) Bennand, Clyne (1977) Ambidge, et al (1976) Baulch, et al (1976) Baulch, et al (1972) Baulch, et al		*This survey	250-700	1.46 x 10 ⁻¹⁰ exp(-593/T)	
Remand, Cyror (1977) 300-730 (1.41 ± 0.24) x 10 ⁻¹ 0-xxy(-6575 ± 6577) Hagner, et al (1976) 292-434 (1.44 ± 0.26) x 10 ⁻¹ 10-xxy(-6500 ± 70/71) Ha c c c c c c c c c c c c c c c c c c				Based on data in Bemand,	et al
Mandage, et al (1976) Ambidge, et al (1976) Ambidge, et al (1976) H + CG + M - HCG + M Builth, et al (1972) H + CH ₂ G + H ₂ + CHG Ridley, et al (1972) H + CH ₂ G + H ₂ + CHG Ridley, et al (1972) H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + NG H + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + CH ₃ GH + NG H + CH ₃ GH + NG H + CH ₃ GH + CH ₃ GH + NG H + NG H + CH ₃ GH + NG H + CH ₃ GH + NG H + NG H + CH ₃ GH + NG H + NG H + CH ₃ GH + NG		Bemand, Clyne (1977)	300-730	$(1.41 \pm 0.24) \times 10^{-10} \exp(-575 \pm 65/T)$	
Abulch, et al (1976) Abulch, et al (1976) Baulch, et al (1976) Baulch, et al (1976) Baulch, et al (1976) Baulch, et al (1972) Baulch, et al (1972) Baulch, et al (1972) CE2 - H6 - H6 - H6 - H6 Baulch, et al (1972) Baulch, et al (1972) CE3 - H2 Baulch, et al (1972) CE3 - H2 Baulch, et al (1972) CE3 - H2 CE3 - H		Wagner, et al (1976)	252-458	* 0.28) x 10 10 exp(600 *	
H + Cd2 - Hd + Cd + M + HGd + M H + Cd2 - Hd + Cd + M H + Cd2 - Hd + Cd H + Cd3 - Hd + Hd H + Cd3 - Hd + Hd H + Cd3 - Hd + Hd H + Cd + Hd + Hd H + Hd + Hd H + Hd + Hd + Hd		Ambidge, et al (1976)	292-434	4	
H + CH2d - H2 + CH3 H + CH3d - H3d (A) H + CH3d - H3d (A) H + CH3dH - CH3dH + Nd (A) - CH3d2 + H2 (b) - CH3d4 + H3 (c) Moortgat, et al (1977) H + CH3Cl - HCl + CH3 Westenberg, delaas (1975a) Boulch, et al (1972) review Hd + Hd + Hd + Hd Hd + Hd + Hd + Hd Hd + Hd +	18,45M			ן רי	
H + CH2 d - H2 + CH3 Ridley, et al (1972) Ridley, et al (1972) Ridley, et al (1972) Westenberg, deliaes (1972b) - CH3 dH + CH3 dH + CH3 d + H2 (c) Slemr, warneck (1977) H + CH3 dH - CH3 dH + Nd (a) - CH3 dH + Nd (a) - CH3 dH + Nd (a) H + CH3 dH - H2 (c) Rortgat, et al (1972) Rortgat, et al (1972) review H + CH3 CL + HCl + CH3 Westenberg, deliae (1975a) H + CH3 CL + HCl + CH3 Westenberg, deliae (1975a) H + CH3 dH + H + H2 Sloue, or all (1972) review HG + HG - H2 dH + HG HG + HG - H2 dH d + H Sloue, or all (1972) review HG + HG - H2 dH d t) Sloue, or all (1972) review HG + HG - H2 dH d t) Sloue, or all (1972) review HG + HG - H2 dH d t) Raulch, et al (1972) review HG + HG - H2 dH d t) Sloue, or all deliae (1973) Raulch, et al (1972) review HG + HG - H2 dH d t) Sloue, or all deliae (1973) Raulch, et al (1972) review HG + HG - H2 dH d t) Sloue, or all deliae (1973) Raulch, et al (1972) review HG + HG - H2 dH d t) Sloue, or all deliae (1973) Raulch, et al (1972) review HG + HG - H2 dH d t) Sloue, or all deliae (1973) Raulch, et al (1972) review HG + HG - H2 deliae (1973) Raulch, et al (1972) review HG + HG - H2 deliae (1973) Raulch, et al (1972) review HG + H2 deliae (1973) Raulch, et al (1973) Raulch, et al (1973) review HG + H2 deliae (1974) Raulch, et al (1972) review HG + H2 deliae (1974) Raulch, et al (1972) review HG + H2 deliae (1974) Raulch, et al (1973) review HG + H2 deliae (1974) HG + H2 deliae (1975) HG +		_	298-773	x 10 3 exp(-850/T), M =	±0.12
Ridley, et al (1972) Westenberg, deHaas (1972) H * CH3GH * L6 L6 L6 L6 L7 L7 L7 L7 L8	18,46	H + CO ₂ + HO + CO H + CH ₂ O + H ₂ + CHO			
# CH30H - CH30 + H20 (a) # CH30H - CH30 + H20 (a) - CH30P - H20 (a) - CH30P + H2 (b) - CH20H + H2 (c) # CH30H - CH30H + H2 (c) # CH30H - H2 + H2 (c) # CH30H - H2 + H2 (c) # CH30H - H2 + H2 (c) # CH30H - H20 + H2 (c) # CH30H - H20P		2 2 2 Part 1 (2020)	200	41.0.14	40
H + CH306H + CH307 + H2 (c) Slemr, Warneck (1977) Slemr, Warneck (1977) Slemr, Warneck (1977) CH206H + H2 (c) H + CH30H + CH30H + H2 (c) Moortgat, et al (1977) H + CH3CL + HC1 + CH3 H + CH3CL + HC1 + CH3 H + CH3CL + HC1 + CH3 Westenberg, deHaas (1972) review H0 + H0 - H2 + H0 H0 + H2 + H0 + H2 H0 + H2 + H0		Westerhers deless (1972)	297=652	× 10=11	
Slemr, Warneck (1977) Region of the change (1977) H + CH ₃ CH + H ₂ (c) Moortgat, et al (1977) H + CH ₃ CH + CH ₃ CH + NG (a) - CH ₃ GH + H ₂ (b) - CH ₃ GH + H ₂ (c) Moortgat, et al (1977) Region of the change (1978) H + CH ₃ CH + CH ₃ CH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH + NG (b) - CH ₃ GH + NG (a) - CH ₃ GH	0. C.	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	300	24	
Slemr, Warneck (1977) Slemr, Warneck (1977) Slemr, Warneck (1977) H + CH ₃ GNG + CH ₃ GNH + NG (a) - CH ₂ GNG + H ₂ (b) - CH ₃ GNG + H ₂ (b) - CH ₃ GNG + H ₂ (b) H + CH ₃ CI + HCI + CH ₃ Westenberg, dehaæ (1975a) H + CH ₃ CI + HCI + CH ₃ Westenberg, dehaæ (1975a) HG + M - H + G + M HG + HG - H + HG ₂ Baulch, et al (1972) review HG + HG - H ₂ + HG HG + HG - H ₃ + HG HG + HG - H ₄ + HG HG + HG - H ₂ + HG HG + HG - H ₂ + HG HG + HG - H ₃ + HG HG + HG - H ₄ + HG HG + HG - H ₂ + HG HG + HG - HG HG + HG HG		CH362 + H2			
Slemr, Warneck (1977) Slemr, Warneck (1977) H + CH ₃ dNd - CH ₃ dH + Nd (a) - CH ₃ dNd + H ₂ (b) - CH ₃ dN d + H ₂ (b) - CH ₃ d d + H ₂ (b) - CH ₃ d d + H ₂ (b) - CH ₃ d d + H ₂ (b) - CH ₃ d d + H ₂ (b) - CH ₃ d d + H ₂ (c) Moortgat, et al (1977) Restenberg deflace (1975a) H + CH ₃ Cl - HCl + CH ₃ Westenberg deflace (1975b) H + CH ₃ Cl - HCl + CH ₃ Westenberg deflace (1975c) H + CH ₃ Cl - HCl + CH ₃ Westenberg deflace (1975c) H + CH ₃ Cl - HCl + CH ₃ Westenberg deflace (1975c) H + CH ₃ Cl - HCl + CH ₃ Westenberg deflace (1977c) Salanch, et al (1972c) H + H ₂ + H ₂ + H ₃ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + H ₄ H + CH ₃ Cl - HG + H ₄ H + CH ₃ Cl - HG + H ₄ H + CH ₃ Cl - HG + H ₄ H + CH ₃ C		+ H2		:	
H + CH ₃ dNd - CH ₃ dH + Nd (a) - CH ₂ dNd + H ₂ (b) - CH ₂ dNd + H ₂ (b) - CH ₃ dH + Nd (c) - CH ₃ dH + CH ₃ (c) - CH ₃ dH + CH ₃ (c) - CH ₃ dH + Nd (c) -		Slemr, Warneck (1977)	250=358	± 0.9) x 10^{-13} exp($-930 \pm 95/T$)	rall rate const
H + CH ₃ GNG - CH ₃ GH + NG (a) - CH ₂ GNG + H ₂ (b) - CH ₂ GNG + H ₂ (b) - CH ₃ GNG +				0.43 #	
H + CH ₃ GNG - CH ₃ GN + NG (a) - CH ₂ GNG + H ₂ (b) - CH ₃ GNG + H ₂ (c) - CH ₃ GNG +					
Moortgat, et al (1977) $223-398$ $k = (4.3 \pm 0.9) \times 10^{-1}^3 \exp(-950 \pm 55/T)$ $k_a/k = 0.47 \pm 0.05$ $(k_b + k_c)/k = 0.52 \pm 0.05$	18,54	+ CH ₃ 6N6 + CH ₃ 6H + N6 + CH ₂ 6N6 + H ₂ + CH ₃ 6 + HN6			
H + CH ₃ Cl - HCl + CH ₃ Westenberg, deHaas (1975a) Baulch, et al (1972) review HG + M - H + HG ₂ HG + HG - H + HG ₂ Had + HG - HG + HG + HG ₂ Had + HG - HG + HG + HG ₂ Had + HG - HG + HG ₂ HG + HG - HG + HG (r) HG + HG - HG (r) #Baulch, et al (1972) review HG + HG - HG + HG (r) #Baulch, et al (1972) review HG + HG - HG + HG (r) #Baulch, et al (1972) review HG + HG - HG + HG (r) #Baulch, et al (1972) review HG + HG - HG + HG (r) #Baulch, et al (1972) review			223=398	* 55/T)	rall rate const
H + CH ₃ Cl - HCl + CH ₃ Westenberg, deHaas (1975a) 500-800 6.2 x 10 ⁻¹¹ exp(-4650/T) HØ + M - H + Ø + M Baulch, et al (1972) review HØ + HØ - H + HØ ₂ Baulch, et al (1972) review HØ + HØ - HØ + BØ + Ø (f) HØ + HØ - HØ + BØ + Ø (f) HØ + HØ - HØ + HØ (r) *Baulch, et al (1972) review HØ + HØ - HØ + BØ + Ø (f) #Baulch, et al (1972) review HØ + HØ - HØ (r) *Baulch, et al (1972) review 300-2000 k _f = 1.0 x 10 ⁻¹¹ exp(-550/T) *Baulch, et al (1974) 1500-2000 k _f = 9.1 x *10 ⁻¹² Westenberg, deHaas (1974) 300 K, = 2.3 x 10 ⁻¹²				= 0.47 ± 0.05	
Westenberg, dehaas (1972) Westenberg, dehaas (1972) Westenberg, dehaas (1972) Westenberg, dehaas (1972) Westenberg, dehaas (1973) Westenberg, dehaas (1973) Soo=800 6.2 x 10 ⁻¹¹ exp(=4650/T) No recommendation No re	0	100 100 100 100 100 100 100 100 100 100		+ k _c)/k = 0.53 ±	
Westenberg, deHaas (1975a) Westenberg, deHaas (1973a) Soo=800 6.2 x 10 *** exp(=4650/T) No recommendation (E/R *** 50000 K) Soo=800 Soo=800 No recommendation (E/R *** 50000 K) Soo=800 No recommendation No recommend		Eug. 190			
Baulch, et al (1972) review HØ + HØ - H + HØ2 HØ + HØ - H_2 + Ø2 Baulch, et al (1972) review HØ + HØ - H_2 O O O O O O O O O O O O O O O O O O O	0	(1975a	500-800	×	
H0 + H0 - H + H02 H0 + H0 - H ₂ + O ₂ Baulch, et al (1972) review H0 + H0 - H ₂ O (f) 0 + H ₂ O - H0 + H0 (r) *Baulch, et al (1972) review 300-2000 *g = 1.0 x 10 ⁻¹¹ exp(-550/T) *Baulch, et al (1972) review 300-2000 *g = 1.1 x 10 ⁻¹⁰ exp(-9240/T) *Rawlins, Gardiner (1974) *goo-2000 *g = 9.1 x 10 ⁻¹² *Westenberg, deflags (1973a)		2			
H0 + H0 - H ₂ + 6 ² Baulch, et al (1972) review H0 + H0 - H ₂ 0 + 0 (f) 9 + H ₂ 0 - H0 + H0 (r) *Baulch, et al (1972) review 300=2000 *gr = 1.0 x 10 ⁻¹¹ exp(=550/T) *Rawlins, Gardiner (1974) 1500=2000 *gr = 9.1 x 10 ⁻¹⁰ exp(=3500/T) *Westenberg, deflace (1973a)	19,19				
Baulch, et al (1972) review HG + HG + G (f) G + H ₂ G - HG + HG (r) *Baulch, et al (1972) review 300-2000 $_{f}$ = 1.0 x 10 ⁻¹¹ exp(-550/T) *Rawlins, Gardiner (1974) Westenberg, GeHags (1973a) 300 $_{f}$ = 9.1 x 10 ⁻¹⁰ exp(-3500/T)	19,19	НӨ + НӨ → Н2 + Ө2			
H0 + H0 + H2 + O (f) 0 + H2 + H0 + H0 (r) *Baulch, et al (1972) review 300-2000 k _f = 1.0 x 10 ⁻¹¹ exp(-550/T) *Rawlins, Gardiner (1974) 1500-2000 k _f = 9.1 x 10 ⁻¹⁰ exp(-2500/T) Westenberg, Gehans (1973a) 300 k _f = 2.3 x 10 ⁻¹²		Baulch, et al (1972) review			
ew 300-2000 $k_f = 1.0 \times 10^{-11} \text{ exp(-550/T)}$ 300-2000 $k_f = 1.1 \times 10^{-10} \text{ exp(-9240/T)}$ 1500-2000 $k_f = 9.1 \times 10^{-11} \text{ exp(-3500/T)}$ 300 $k_f = 2.3 \times 10^{-12}$	19,19	HG + HG + H ₂ G + G (f)			
300=2000 $k_{\rm F}$ = 1.1 x 10 ⁻¹⁰ exp(=9240/T) 1500=2000 $k_{\rm f}$ = 9.1 x 10 ⁻¹¹ exp(=3500/T) 300 $k_{\rm f}$ = 2.3 x 10 ⁻¹²		*Baulch, et al (1972) review	300-2000	- 1.0 x 10-11	±0.2
1500-2000 $k_{\rm f} = 9.1 \text{ x}^3 10^{-11} \text{ exp(-3500/T)}$ 300 $k_{\rm f} = 2.3 \text{ x} 10^{-12}$			300-2000	- 1.1 x 10-10	±0.2
300 k. = 2,3 x 10 12		Rawlins, Gardiner (1974)	1500-2000	= 5.1 x 10-11	
		West of State of Stat	006	= 0.3 × 10=12	*O. O.

c temper		i i		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	* * Preferred Value	Range/K	k/cm molecule 1s 1	Reliability of
No.	+ = NASA (1977) eval			log k
	(2634) [2 42 2]	000	4	
	mchenzie, et at (19/3)	0.43	1 1 1	
	Clyne, Down (1974)	300	$k_f = 1.4 \pm 0.2 \times 10^{-12}$	
		300	- 1.7 * 0.6 x	(B)
	Trainor, von Rosenberg (1974)	300	= 2.1	
	Wilson (1972) review	300	kp * 2.57 x 10"12	.0.1, ec.5
			(a) Evaluation based on authors' work	
19,19M 23,M	$HG + HG + N + H_2G_2 + M$ (f) $H_2G_2 + M + HG + HG + M$ (r)		-d[0H]/dt = 2k[0H] ⁻ [M]	
	A (1977) eval	200-300	$k_* = 1.25 \times 10^{-32} \text{ exp(900/T)}$	(a)
			(a) Accepts room temp value of Trainor,	
			von Rosenberg. E/R value chosen same	
	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		as for comb. of OH wit	
	You rosenberg	000	* C • O • C • V •	
	Baulch, et al (1972) review	700-1500	. = 2.5 x 10 % exp(+2550/T)cm molecule	
			N N N N N N N N N N N N N N N N N N N	
			= 2.0 x	1, ±0.3 at 1500K
			M * N2; kf * krKeq	
19,20	HG + HO2 → H2G + G2		:	
	+*NASA (1977) eval	200-300		0.5 at 230K
	Burrows, Harris, Thrush (1977)	293		(a)
			(a) Based on $K(H\theta + H_2\theta_2) = 7.9 \times 10^{-1.5}$	
	Lloyd (1974) review	300-1000	8.3 x 10 ⁻¹¹ exp(-500/T)	€0.4
	Hochanadel, et al (1972)	300		
	DeMore, Tschulkow-Roux (1974)	300	1.1 x 10-10	#0.5 (B)
			(a) Adjusted value - based on reported	
			ratio and values of $k(\theta_3 + H\theta)$ and	
10 21	# + # # # # # # # # # # # # # # # # # #		K(HO ₂ + HO ₂) in this survey.	
	**************************************	0000	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	4000
	Wilson (1972) review	300-2000	exp(=2600/T)	
	Stuhl, Niki (1972)	298	x 10-15	\$0.0 \$
	Westenberg (1973a)	298	×	±0.04
		352	×	
		403	×	
		518	×	
		628	×	
		745		
	Smith, Zellner (1974a)	210-460	1.8 x 10 ⁻¹¹ exp(-2330/T)	
	Gardiner, et al (1974)	1350-1600	x 10-11	
	Greiner (1969)	300-200	×	±0.15
	Atkinson, Hansen, Pitts (1975)	297-434	5.9 x 10 ⁻¹² exp(-2008 ± 150/T)	

+ * NASA (1977) eval		COSON WO /W	A/CIII III II CICICIC S	Reliability of
Overend, et al (1975)	295	(5.80 ± 0.26) x 10-15	-15	
Trainor, von Rosenberg (1975)	300	×		
HG + D ₂ + HDG + D		zz idva ot v zer		
Smith, Zellner (1974a)	210-460	1.25 x 10-11 exp(-2550/T)	2550/T)	
H6 + H26 → H262 + H				
Baulch, et al (1972) review He + H.O H.O + HO.		no recommendation		
2-	1	1		6
**NASA (1977) eval	200=300	1 x 10 -exp(-750/T)		*0.3 at 230K (a)
Hack, et al (1975)	298-670		0/T)	
Greiner (1968)	300-458	4.1 x 10 "T" exp	(=600/T)	4
nampson (1973) quoting Banlch, et al (1972) review				• • • • • • • • • • • • • • • • • • • •
	300	KAK(HØ + CØ) = 8.13	Įri,	
Meagher, Heicklen (1974)	208		# 0.6	
		(a) Based on results of	lts of Hack, et al (1975)	
th tone		and Greiner (1968)	1968)	
2				1
	1600-2100	7 x 10 ::		L *0#
Baulch, et al (1973) reviw $H\theta + HN\theta_2 - H_2\theta + N\theta_2$	2000	6 x 10		0 0 #
Cox, Derwent, Holt (1976)	296	(6.6 ± 0.3) x 10 ⁻¹²	Q:	
		rxn is H0 +	H2 - H26 + H with	
	,	Kref = 7 x 10 15		
COX (1974a)	294	k/k(He + Ce) = 15	t lat latmair	
m I				
**SBith, Zeliner (1975)	240-406	8 ± 2 × 10 = .		#0.1 at 230K (a)
Hampson, of al (1973) review	300=650	6 v 10 13 evn(a400	Ę	u .
Johnston (1974) review	300-700	(1.5 +0 2.0) × 10	13,	0 0 0
Baulch, et al (1973) review	300	1.3 x 10=13		E *0#
		(a) Value recomme	by authors for T -	298K.
HG + SG + M + HSG3 + M				
Davis (1976)	300	1013 K K	P(He)/torr 50	(0)
		1.6 * 0.1	150	
		2.7 * 0.2	500	
		101 3 x K	P(Ar)/torr	
		44	50	
		N.0 + 0.0	150	
		(A)	500	
		4 4 0-0	177 2 17 18 EE	
		1 41	0 0	

December 1977	. 1977			
	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and
No.	+ NASA (1977) eval	vou8e/v	K/CH Molecule us	kellability of log k
			0.3	
			~9 (b) Extranolated value.	
	Harris, Wayne (1975)	300	# 1.5 x 10 31 cm molecule 2s 1, h	
	Cox (1974a)	400	7.2 # Z.0 x 10 - 3 M # N2 W/K(HG + C.6) # A + O.5	(0)
			(c) 2nd order rate constant, [M] = 1 atm. N2	ر 0
	Gordon, Mulac (1975)	435	see entry for k(Hd + Cd) 1.8 x 10 ⁻¹² cm ³ molecule ⁻¹ g ⁻¹	
				•
	Castleman, Tang (1977)	297	1.6 x 10 31 cm 6 molecule 2 s 1, M = N2	
			k/k(H6 + Ce) = 4.3 (d) Measured ratio of 2d order rate constants at 1 atm No.	(d)
			Values for k given in paper assumed k	1.5 x 10 13
			over entire pressure range. See entry for k(AH + CA)	for k(dH + CM)
	Atkinson, Perry, Pitts (1976)	298	10 ¹³ x k P(Ar)/torr	(e)
			2.16 50	
				•
19,32	SH + 9°H + SH + 9H		(e) Effective 2nd order rate constant in cm ³ molecule ¹ s ¹	sw _s molecule's'
	Baulch, et al (1976) review	300= 500	1.05 x 10-11 exp(-200/T)	#0 15
	•	297-427	(5.2 ± 0.5) x 10 ⁻¹²	
	Stuhl (1974)	298	3.1 ± 0.5 x 10"12	
19,35	H6 + C1 → Ø + HC1		see reverse reaction	
19,39	He + Hel + He + Cl			
		220-300	×	#0.1 at 230K
	Smith, Zellner (1974a)	210-460	4.1 x 10 12 exp(_530/T)	
	Zahniser, et al (1974)	224-460	2.0 * 0.1 x 10"12 exp(-312 * 10/T)	
	Takacs, Glass (1973)	295	6.4 #1.5 x 10 13	*0*
	Davis (1974)	300	6.5 ± 0.4 x 10 ^{-1.5}	
19,39	He • DCl • HDe • Cl			
19.39Br	Smith, Zellner (1974a) HØ + HBr - H_Ø + Br	210-460	4.7 x 10 1 2 exp(-780/T)	
	Z = Z = Z = Z = Z = Z = Z = Z = Z = Z =	ć f		
19,43a	T*lakacs, Glass (1973) HØ + NØ3Cl - products	300	5.1 X 10	#0.36 at 230K
	+*Zahniser, et al (1977)	246=387	$(1.19 \pm 0.10) \times 10^{-12} \exp(-333 \pm 22/T)$	#0.36 at 230K
	Ravishankara, et al (1977)	245	3.7 x 10 13	
19,45	H6 + C6 + C62 + H (f)			
0 1	<u>.</u>			
	+NASA (1977) eval	200-400	kf = 1.4 x 10 13 low pressure value	*0*1

December 1977	;		:		
	keaction/kererence * * Preferred Value	Temp. Range/K	k/cm ³ mole	Keaction Rate Constant K/cm ³ molecule ⁻¹ s ⁻¹	Notes and Reliability of
No.	+ = NASA (1977) eval				log k
	*Baulch, et al (1976) review	250-2500	log k _f = -12.95 + same as given in Erecommendation bas	$\log k_f = -12.95 + 3.94 \times 10^{-4} \times T$ same as given in Baulch, Drysdale (1974) recommendation based on low pressure studies	*C.)
		1000-3000	kr " kg/Keg " 2.5	" kf/Keg = 2.5 x 10-10 exp(-13330/T)	*0.1
	#This survey	300		1 atmosphere air	±0.1 (a)
				Tentative rec. Recent experiments at room temperature have shown an apparent increase in k in the presence	at room temperature
			of SF6, H2,	of SF6, H2, N2/62 but not He or Ar.	
			Biermann, et	Biermann, et al (1978) have identified a combined	fled a combined
			have a signi	effect of inert gas and σ_2 , trace impurities of σ_2 have a significant effect and 1 torr is sufficient	impurities of control or is sufficient to
			produce the	produce the limiting rate constant in the presence	
			of 1 atm of	• 8 Z	
			Experiments bear	on the pres	fect."
	,		;	5	aole iractions
	Butler, et al (15//)	298	Krckref 0.094	100	N2_C_02_C_C0
			0.10		0.50/0.34/0.15
			0.17	300 0.73/0	0.73/0.17/0.08
			0.15		0.50/0.34/0.15
			0.16	0/21.0	0.73/0.17/0.07
			0.18	600 0.74/0	0.74/0.17/0.08
				-	with 6-28%
				side rxn. Ratios calcul	ated from reported
				authors' value for kref " 1.	for kref " 1.59 x 10"12 which was
				in the 100 torr expt. relative to	ve to
	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		9	x 30	
	Chan, et at (1977)	967	147 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	100 in "synthetic	\$ L
			0.127		
			Ref. rxn is H6 +	Isobutane - products	
	Sie, Simonaitis, Heicklen (1976a)		kr/kref	P/torr	
		217-298	0.2exp(1700/T)	high pressure limit in H2	n H2
		298	14		
			21		
			Q; (C	296 (42)	
			a t ((H ₂)	
			17	(He) + 28 (
			n (0 0	
			rxn is H6 •	, E	
	Cox, Derwent, Holt (1976)	296		P/torr	
			38.6	700 N2/02 = 2	
			Ref. rxn. is He + H2	E	
	Atkinson, Perry, Pitts (1976)	299	(1.54 * 0.16) x 1	0=13 P = 25=654 torr Ar	Ar
-	The same of the sa		-		

December 1977	r 1977			0.000
	Reaction/Reference	Temp.	Reaction Rate Constant	
No.	+ - MASA (1977) eval	range/	K/CB Botecute s	retiability of log k
	Perry, Atkinson, Pitts (1977a)	299	*	
	dverend, Paraskevopoulos (1977)	296	3.43 (2.03 ± 0.08) x 10-13 at 50 torr He (3.24 ± 0.20) x 10-13 at 200, 350 torr	SF.
	Gordon, Mulac (1975)	8 52	1.50 x 10-13 at 710 torr Ar, 10 torr H ₂ 0 Experiments either at low pressure or for which pressure effects were not studied.	or_which
	Trainor, von Rosenberg (1975) Vandooren, et al (1975)	300 400=800 1000=1800	1,25 x 10 ⁻¹³ 1,33 x 10 ⁻¹³ 3,85 x 10 ⁻¹² exp(-2850/T)	
	Biordi, et al (1975) Steinert, Zellner (1975)	1350-1750	7.8 x 10"13 log k = = 12.93 + 4.0 x 10"4 x T	
	Wilson (1972) review Stuhl, Niki (1972)	300-2000	5.1 x 10 ⁻¹³ exp(~300/T) 1.35 x 10 ⁻¹³	r) *0 # #
	Westenberg, deHaas (1973a)	298 396 523 707 915	11.00 X 100 11 10 10 10 10 10 10 10 10 10 10 10	40°°
	Davis, Fischer, Schiff (1974) Greiner (1969) Smith, Zellner (1973)	300-500	2.15 ± 0.19 x 10 13 exp(-80 ± 40/T) 2.15 x 10 13 exp(-115/T) 1.45 x 10 13 (b) Data reported 210 'T' 460 K. Slight positive temerature dependence, possibly curved,	#0.04 #0.1 positive (b)
19,48	Peeters, Mahnen (1973) Gardiner, et al (1973) Howard, Evenson (1974) $H\theta \leftrightarrow CH_2\theta \to H_2\theta \leftrightarrow CH\theta$	1600=1900 1500=2000 296	4.7 x 10=13 6.7 x 10=12 exp(-4000/T) 1.56 ± 0.2 x 10=13	
	+*NASA (1977) eval *Worris, Niki (1971) Wilson (1972) review Peeters, Mahnen (1973)	200-300 300-1600 1400-1800	3 x 10 11 exp(-250/T) 1.4 x 10 11 8 x 10 11 3.8 x 10 11 (a) "A factor" chosen; Eact fitted to room temp value of Morris, Niki	#0.4 at 230K (a) #0.1 #!
19,52	HØ + CH ₃ ØH → products Campbell, et al (1976) HØ + CH ₃ NØ ₂ → products	292	9.5 x 10 13	
19,54	Campbell, Goodman (1975b) HØ + CH ₃ ØNØ + products Campbell, Goodman (1975b)	2 00	S 100 X 2.00 E 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
		262	>	

, o o o o o o o o o o o o o o o o o o o	- NASA (1077) ASAN = +		S C M MO CC C	
9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	4000			log k
	H0 + CH4 + CH3 + H26			
	+*Davis, Fischer, Schiff (1974)	240-373	2.36 ± 0.21 x 10 ⁻¹² exp(-1710 ± 88/T)	*0.04
	Margitan, et al (1974)	290-440	exp(-1840 * 20/T)	*0.06
	Wilson (1972) review	300-2000	4.7 x 10-11 exp (-2500/T)	40.7
	Overend, et al (1975)	300	6.51 ± 0.26 x 10-15	
	Peeters, Mahnen (1973)	1100-1900	5 x 10 11 exp(-3000/T)	
	Greiner (1970)	300-200	5.5 x 10-12 exp(-1900/T)	*0.1
	Gordon, Mulac (1975)	381	2.6 x 10-14 (1 atm H26 vapor)	
		416	5.5 x 10-14 (1 atm H26 vapor)	
	Zellner, Steinert (1976)	300-900	x 10-21 +3.	
	Howard Evenson (1976)	296		
	Cox, Derwent, Holt (1976)	296	(7.3 ± 0.9) x 10-15	
			k_s = 7 x 10 15	
19,56a	He · C2H2 - products		4 0	
	Smith, Zellner (1973)	210-460	2.0 x 10-12 exp(-250/T)	
	Pastrana, Carr (1974)	000	2.0 ± 0.5 × 10-13	
	Davis of al (1975)	002	* A A A A A A A A A A A A A A A A A A A	
19,57) •	
	t v			
	Atkinson, Perry, Pitts (1977)	299-425		(8)
			(a) High pressure values (225-660 torr Ar)	
			Values also given for 25 and 75 torr	
	Howard (1976)	596	pressure dependent values given over range 1	1 to 7 torr He
	Overend, Paraskevopoulos (1977)	296	1.0 * 0.2 x 10-11	(a)
			(b) Authors' suggested limiting high pressure value based	re value based
			on expts at 400 torr SF6 and CF4 and analysis o	and analysis of
			dependence of k on [H20] at low values	of [H2e]
	Stuhl (1973c)	298		€0.12
	Smith, Zellner (1973)	210-460	7.5 x 10 12 exp(-110/T)	
			집	
	Davis, et al (1975)	300		
			300	
		300	3.64 x 10-12 at 3 torr N2	
	Morris, et al (1971)	300		
	Bradley, et al (1973)	300	1.7 t 0.5 x 10"12	
	Greiner (1970a)	300-500	1.25 x 10-12 exp(454/T) at 100 torr He	
	Gordon, Mulac (1975)	381	6.2 x 10-12 (1 atm H26 vapor)	
		416		

9	Temp.	Stant	
- Prefer	Range/K		Reliability of
- NASA (1			log k
			-
HØ + C ₂ H ₆ → products			
Gwerend et al (1975)	00	2.64 ± 0.17 × 10-13	
Gration (1970)	300-200	1.86 x 10 11 exp(=1030/T)	
Howard Evenson (1976)	296	(2.9 * 0.6) x 10-13	
HØ + C ₂ H _e - products			
A+tringon Di++s (1075h)	207-425	4.1 x 10=12 exp(540 ± 150/T)	
C4.11 (1073.)	208	1 A5 ~ 10=11	90
stunt (19/3c)	067		00.0
Morris, et al (1971)	300	1.7 × 10 °°°	
Bradley, et al (1973)	300	* 1.7 x 10 ⁻¹²	
Gorse, Volman (1974)	300	k/k(ce + He) = 89.3 (low pressure)	
		$k = 1.2 \times 10^{-11}$	(a)
		(a) k(C6 + H6) = 1.4 x 10 al3, this survey	
Davis (1976)	300	1.53 * 0.06 x 10 11	
Gordon, Mulac (1975)	381	:	
	416	2	
He . n-CAH, - products			
Stub (1973b)	300	2.35 x 10-12	*0.06
5	207=420	1.76 v 10-11exp(-560/T)	•
•	005-005	1.41 x 10 = 11 exp(a 504 / T)	
Control Volume (1974)	000		
of local and))	K = 2.7 × 10 = 12	(a)
		(a) $k(C\theta + H\theta) = 1.4 \times 10^{-13}$, this survey	
H6 * isobutane * products			
Greinen (1970)	300-500		
Gorse Volmen (1974)	300		
)	X = W.3 × 10-12	(3)
		(a) $k(C\theta + \theta H) = 1.4 \times 10^{-13}$ this survey	ì
Butler, et al (1977)	300	1.6 x 10-12	(P)
		(b) Determined in expt. at 100 torr relative to $k(HR + CR) = 1.5 \times 10^{-13}$	
+			
	300-200	$k = [1.0 \text{ exp}(-820/T) \text{ N}_{\text{D}} + 2.3 \text{ exp}(-430/T)]$	
		$N_2 + 2.1 \exp(+95/T) N_+] \times 10^{-12}$	
		where No. Ns. and Nt are the number of primary	
		8	٠
		Do not use formula for CH4 and C2H6.	
	298		torr Ar
	380-470	$k_1 = 4 \times 10^{-11} \exp(-2000/T)$	(a)
	298	k ₁ /k = 0.05	(P)
		(a) k ₁ refers to abstraction rxn	
Hansen, Atkinson, Pitts (1975)	298	(1.24 ± 0.12) x 10-12 total rxn; P = 50-600	= 50=600 torr Ar
	H6 + C ₂ H ₆ - products Gverend, et al (1975) Greiner (1970) H0 ward, Evenson (1976) H0 + C ₃ H ₆ - products Atkinson, Pitts (1975) Stuhl (1973c) Morris, et al (1973) Gorse, Volman (1974) Badley, et al (1973) Gorse, Volman (1974) H0 + n-C ₄ H ₁₀ - products Stuhl (1973b) Gorse, Volman (1974) H0 + isobutane - products Greiner (1970) Gorse, Volman (1974) H0 + alkane - H ₂ Ø + alkyl radical Greiner (1970) HØ + alkane - H ₂ Ø + alkyl radical Greiner (1970) HØ + Alkinson, Pitts (1977) HØ + C ₆ H ₆ - products HØ + C ₆ H ₆ - products	1	200-500 1.64 ± 0.17 x 10-13 300-500 1.68 x 10-11 exp(-1230/T) 296 297-425 4.1 x 10-12 exp(540 ± 150/T) 296 297 x 10-12 x 10-12 300 5.0 x 1.7 x 10-12 300 K/k(CG + HG) = 69.3 (10w pressure) k = 1.2 x 10-13 300 k/k(CG + HG) = 1.4 x 10-13, this survey 1.53 ± 0.06 x 10-11 (1 atm HgG vapor) 416 2.0 x 10-11 (1 atm HgG vapor) 300 2.35 x 10-12 (1 atm HgG vapor) 300 6.7 x 10-12 exp(-560/T) 300 6.7 x 10-12 exp(-560/T) 300 6.7 x 10-12 exp(-580/T) 300 k/k(HG + CG) = 23.5 (10w pressure) k = 3.3 x 10-12 exp(-580/T) 300 k/k(HG + CG) = 1.9 4 (10w pressure) k = 3.3 x 10-12 exp(-580/T) 300 k/k(HG + CG) = 1.5 x 10-13, this survey 300 6.7 x 10-12 exp(-580/T) 300 k/k(HG + CG) = 1.5 x 10-13, this survey 300 k/k(HG + CG) = 1.5 x 10-13, this survey 1.6 x 10-12 exp(-580/T) Ny 1 x 10-12 Where Ny Ns and vertee number of prime econdary, and tertiary hydrogen atoms resp Do not use formula for CH4 and CH6 296 (1.20 ± 0.15) x 10-12 exp(-200/T) 296 (1.20 ± 0.15) x 10-12 exp(-200/T) 297 (1.20 ± 0.15) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated to 298 (1.20 ± 0.12) x 10-12 expression for k extrapolated for k extrapolated for

December 1977	1977			
		Temp.	Reaction Rate Constant	Notes and
, and	* = Preferred Value	Range/K	k/cm molecule s.	
0	NASA			LOG K
	Davis, Bollinger, Fischer (1975)	298	0.85 x 10=12 p = 3 torr He	total rxn
			×	
19,60a	He · C ₆ H ₅ CH ₃ ~ products		L L	total rxn
	Perry, Atkinson, Pitts (1977)	298	(6.40 ± 0.64) x 10-12 total rxn;	n: P = 200 torr Ar
		380-470	x 10-12 exp(-450/T)	(a)
		298	- 1	(q)
			(a) k _l refers to H atom abstraction	•
			(b) Fraction of Fxn proceeding by abstraction; expression for k, extrapolated to 298K	et ton: 8K
	Hansen Atkingen Ditte (1075)	800	10-12	+0+01 nwn. D = 1000600 +000 be
	T I	208	10-12 P = 3 torr He	
)		x 10=12 P =	total rxn
19,61	HØ * CF,Cl, * products		o.ii x 10 - F = 100 torr He	total rxn
	2 2 2 2 2 2 3 4 5 4 N * +	000	7 × 1 × 10 12 0 × 1 × 1	4
	Attingon Hangen Ditta (1075)	297=424	< > - - -	
		296	۰ 4 ۲ ۲	٥
	Chang, Kaufman (1977)	480	•	(a)
			(a) upper limit only	
			on upper limit	BOK
				"A factor"
19,62	HØ * CFCL * products		chosen; E/R value derived	
•				,
	+*NASA (1977) eval	200-300	~ .	(a,b)
	Atkinson, Hansen, Pitts (1975)	297-424	× ⊷ ι	(a)
	Chang Kantman (1975a)	000	7	8
	Chaire, had than (1977)	0 t		d
			upper timit only	4
			reported by Chang and Kaufman. "A	factor
19,63	He · ccl4 - products			
	Howard, Evenson (1976a)	296	k < 4 x 10 15	upper limit only
19,64	He + CH3C1 - H2e + CH2C1			
	+*NASA (1977) eval	200-300	$2.2 \times 10^{-12} \exp(-1142/T)$	#0.2 at 230K
	Davis, et al (1976)	250-350	$(1.84 \pm 0.18) \times 10^{-12} \exp(-1098 \pm 35/T)$	
	Perry, Atkinson, Pitts (1976)	298-423	$4.1 \times 10^{-1.2} \exp(-1359 \pm 150/T)$	
;	_	296	(3.6 ± 0.8) × 10 14	
19,64	He + CH2CL2 - H28 + CHCL2			
	+*NASA (1977) eval	200-300	10-12exp(-1094/T)	#0.2 at 230K
	Davis, et al (1976)	245=375	$(4.27 \pm 0.63) \times 10^{-1} \text{exp}(-1094 \pm 81/T)$	
	Perry, Atkinson, Pitts (1976)	25 8 5 5 8	44	
	Howard, Evenson (1976)	296	(1.55 ± 0.14) x 10 °C	

December 1977	1977			
	Reaction/Reference	Temp. Range/K	Reaction Rate Constant k/cm_molecule_1s_1	Notes and Reliability of
No.	NASA (1			
19,64	He + CHCl ₃ → H ₂ e + CCl ₃			
	+*Davis, et al (1976)	245-375	$(4.69 \pm 0.71) \times 10^{-12} \exp(-1134 \pm 108/T)$	#0.2 at 230K
	Howard, Evenson (1976a)	296	$1.01 \pm 0.15 \times 10^{-13}$	
19,65	HØ + CHFCl2 - H2Ø + CFCl2			
		200-300	1.3 x 10-12 exp(-1127/T)	#0.2 at 230K
	Perry, Atkinson, Pitts (1976)	298-422		
	Chang, Kaufman (1977)	241-396	4	
	Watson, et al (1977)	245-375	$(1.87 \pm 0.2) \times 10^{-3} = \exp(-1245 \pm 26/T)$	
	Howard, Evenson (1976a)	296	2.6 x 10-14	
19,65	He + CHF2cl → H2e + CF2cl			
	+*NASA (1977) eval	200=300	$1.2 \times 10^{-1.2} \exp(-1660/T)$	#0.08 at 230K
	Atkinson, Hansen, Pitts (1975)	297-434	$1.21 \times 10^{-12} \exp(-1636 \pm 150/T)$	
	Chang, Kaufman (1977)	253-427	$(1.20 \pm 0.16) \times 10^{-1}^{2} \exp(-1657 \pm 39/T)$	
	Watson, et al (1977)	250-350	$(9.25 \pm 1.0) \times 10^{-13} \exp(-1575 \pm 71/T)$	
	Howard, Evenson (1976a)	296	3.4 x 10 125	
19,65	He + CH2FCl → H2e + CHFCl			
	+*Watson, et al (1977)	245-375	$(2.84 \pm 0.3) \times 10^{-12} \exp(-1259 \pm 50/T)$	4°°
	Howard, Evenson (1976a)	296	$3.7 \pm 0.6 \times 10^{-14}$	
19,65	H6 + CH3F → products			
	Howard, Evenson (1976a)	296	16 * 2 × 10"15	
19,65	He + CH ₂ F ₂ → products			
	Howard, Evenson (1976a)	296	7.8 ± 1.2 x 10 ⁻¹⁵	
19,65	He + CHF ₃ → products			
	Howard, Evenson (1976a)	296	2 x 10"16	
19,65	He + CF ₄ - products			
	Howard, Evenson (1976a)	296	k < 4 x 10=16	upper limit only
19,65	H6 * CF3Cl - products			
	Howard, Evenson (1976a)	296	k < 7 × 10 16	upper limit only
19,65	He + CH3Br - H2e + CH2Br			
	+*Davis, et al (1976)	245=350	$(7.93 \pm 0.79) \times 10^{-13} \exp(-889 \pm 98/T)$	#0.2 at 230K
	Howard, Evenson (1976a)	556	35 * 8 x 10=13	
19,65	He + CH ₃ CCl ₃ - products			
	+*NASA (1977) eval	200-300	3.5 x 10-12 exp(-1562/T)	#0.36 at 230K
	Watson, et al (1977)	260=375	$(3.72 \pm 0.4) \times 10^{-12} \exp(-1627 \pm 50/T)$	
	Chang, Kaufman (1977)	275-405	$(1.95 \pm 0.24) \times 10^{-1} exp(-1333 \pm 37/T)$	
	Howard, Evenson (1976b)	296	15 ± 3 x 10 15	
19,65	He + C ₂ HCl ₃ → products			
	+*NASA (1977) eval	200-300	2.3 x 10=12	#0°3€
	Chang, Kaufman (1977)	234-420	$(5.32 \pm 0.71) \times 10^{-1.3} \exp(.445 \pm 41/T)$	
	Davis (1977)	300	2.35 ± 0.25) x 10-12	preliminary
	Howard (1976)	296	$2.0 \pm 0.4 \times 10^{-12}$	

Notes and Reliability of log k	#0.36 at 230K	upper limit only	Larger at higher T *0.3	*0.3 (a) survey.	*1.5 at 230K (a) *1 at 230K (a) ClØ)	e (0)
Reaction Rate Constant k/cm ³ molecule ¹ s ¹ 1	(9.44 * 1.34) x 10 ⁻¹² exp(-1199 * 55/T) (1.06 * 0.5) x 10 ⁻¹¹ exp(-1300 * 150/T) 1.70 x 0.34 x 10 ⁻¹³ (1.15 * 0.15) x 10 ⁻¹² exp(-1748 * 30/T) 2.8 * 0.4 x 10 ⁻¹⁵	k < 3 x 10 ⁻¹⁶ see reverse reaction see reverse reaction -d[H6 ₂]/dt = 2k[H6 ₂] ² 2.5 x 10 ⁻¹² (a) Supersedes result reported in Hamilton (1975) 3.3 x 10 ⁻¹²	x 10-12 x recomme kreq x 10-11 x recomme	-	5 x 10-12 (a) estimate - no data 2 x 10-13 (a) No data; value assumed to he intermediate between k(HH2 + HH2) and k(ClH + ClH)	<10=19 2.5 x 10 ⁼¹⁰ exp(=11900/T)
Temp. Range/K	297-420 260-375 296 273-375 296	S S S S S S S S S S S S S S S S S S S	300-800 300-1000 300-800 300-1000	0 0 m	200-300	300
Reaction/Reference * Preferred Value + * NASA (1977) eval	HØ + C ₂ Cl ₄ - products +*Chang, Kaufman (1977) Davis (1977) Howard (1976) HØ + CH ₃ CF ₂ Cl - products Watson, et al (1977) Howard, Evenson (1976b) HØ + CF ₂ ClCFCl ₂ - products	Watson, et al (1977) HG ₂ + M + H + G ₂ + M HG ₂ + M + HG + G + M HG ₂ + HG ₂ - H ₂ G ₂ + G ₂ +*Hamilton, Lii (1977) Baulch, et al (1972) review	H62 + H2 - H262 + H Baulch, et al (1972) review Lloyd (1974) review H62 + H26 - H262 + H6 Baulch, et al (1972) review Lloyd (1974) review	$H\theta_2 + S\theta_2 \rightarrow S\theta_3 + H\theta$ *Payne, Stief, Davis (1973) $H\theta_2 + Cl \rightarrow HCl + \theta_2$ +*Leu, DeMore (1976)	$HG_2 + Br + HBr + G_2$ +*NASA (1977) eval $HG_2 + Cl\theta + H\theta Cl + G_2$ +*NASA (1977) eval $HG_3 + C\theta + C\theta_2 + H\theta$	*This survey Baulch, et al (1976) review
December 1577 No.	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	20, M 20, M 20, 20	20,21 20,22	20,28	20°30°30°30°30°30°30°30°30°30°30°30°30°30	

	December 1977				
Lloyd (1974) eval. 300=1000 1.7 x 10=13 Lloyd (1974) eval. 300=1000 1.7 x 10=13 Davis Payes Steff (1973) 300 410=20 Simonalite, Heactien (1973) 300 410=20 Simonalite, Heactien (1973) 300 410=20 Simonalite, Paris 4072 300 410=10 Simonalite, Paris 4072 300 410=10 Schyan (1972) 410=10 Sachyan (1972) 713=773 1 x 10=10 Baldwin, et al (1972) 773 1.6 x 10=10 Hog + CH3d = -CH3d + 40 Hog + C2H4 = C2H4 + 407 773 1.6 x 10=14 Hog + C2H4 + 40dition products 300 6.7 x 10=14 Hog + C2H4 + 40dition products 40 Lloyd (1974) review 300 41.7 x 10=17 Hog + C2H6 + H2d2 + C2H5 300=1000 41.7 x 10=17 Hog + C2H6 + H2d2 + C2H5 40.7 x 10=14 Hog + C2H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C2H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C2H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C2H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C2H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Hog + C3H6 + H2d2 + 1-C3H7 40.7 x 10=17 Had + H2d2 + H2d2 + 1-C3H7 40.7 x 10=17 Had + H2d2 + H2d2 + 1-C3H7 40.7 x 10=17 Had + H2d2 + H2d2 + 1-C3H7 40.7 x 10=17 Had + H2d2 + H2d2 + 1-C3H7 40.7 x 10=17 H2d2 + H2d2 + H2d2 + 1-C3H7 40.7 x 10=17 H2d2 + H2d2 + H2d2 + H2d2 + 1-C3H2 40.7 x 10=17 H2d2 + H2d		Reaction/Reference	Temp.	Reaction Rate Constant	
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Simonattis, Heicklen (1973a) 373-473 45 x 10-18 Volumn, Gorse (1970) 713-773 1x 10-18 Baldwin, Weiker, Webster (1970) 713-773 1x 10-10 **Loyd (1974) review 300-800 1,7 x 10-16 Baldwin, et al (1972) 773 1,6 x 10-16 Baldwin, et al (1972) 773 2,5 x 10-17 Baldwin, et al (1972) 773 2,5 x 10-17 Baldwin, et al (1974) review 300 6,7 x 10-14 Bd2 + C2H4 + Hd2 + Hd ? 773 2,5 x 10-17 Bd2 + C2H4 + Hd ? 773 2,5 x 10-17 Bd2 + C2H4 + Hd ? 773 2,5 x 10-17 Bd2 + C3H3 + Hg4 + Hd ? 773 2,5 x 10-17 Bd2 + C3H3 + Hg4 ? 1=C3H7 Bd3 + Hg4 ? 1=C3H7 Bd4 (1974) review and Hg2 Bd5 + C3H3 + Hg4 ? 1=C3H7 Bd5 + C3H3 + Hg4 ? 1=C3H7 Bd6 + C3H3 + Hg4 ? 1=C3H7 Bd7 + C3H3 + Hg4 ? 1=C3H3 + Hg4 ? 1=		Wyrsch, et al (1974)	300	43 x 10 €18	
Baldwin, Walker, Webster (1970) 713-773 1 x 10 ⁻¹⁰ e Varcanyan, Danagran, Sachyan (1972) 878-952 2.2 x 10 ⁻¹⁰ e Sachyan (1972) 878-952 2.2 x 10 ⁻¹⁰ e G. Sachyan (1974) review 300-800 1.7 x 10 ⁻¹² f. H ² ₂ + CH ₂ ² + CH ² ₃ + CH ² ₄ + C ₂ H ₄ + H ² ₃ + C ₃ H ₄ + H ² ₃ + C ₃ H ₄ + H ² ₃ + C ₃ H ₃			373-473	65 x 10 13	v
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C. H ⁶ ₂ + CH ₂ θ + H ₂ θ ₂ + CHθ *Lloyd (1974) review Baldwin, et al (1972) H ⁶ ₂ + CH ₃ θ ₂ + CHθ *Lloyd (1974) review H ⁶ ₂ + CH ₃ θ ₂ + CH σ σ σ σ σ σ σ σ σ σ σ σ σ σ σ σ σ σ				• ¤	Iloyd and the
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C. HG ₂ + CH ₂ G + H ₂ G ₂ + CHG *Lloyd (1974) review Baldwin, et al (1972) T73 1.6 x 10 ⁻¹⁵ (a) Derived (1974) review HG ₂ + CH ₃ G ₂ + CH ₃ G ₂ H + G ₂ Demerjian et al (1972) review HG ₂ + C ₂ H ₄ - C ₂ H ₄ G + HG ? Walker (1973) HG ₂ + C ₂ H ₄ - addition products Lloyd (1974) review HG ₂ + C ₂ H ₅ - H ₂ G ₂ + C ₂ H ₅ Lloyd (1974) review HG ₂ + C ₃ H ₈ - H ₂ G ₂ + C ₃ H ₅ Lloyd (1974) review HG ₂ + C ₃ H ₈ - H ₂ G ₂ + 1=C ₃ H ₇ Lloyd (1974) review HG ₂ + C ₃ H ₈ - H ₂ G ₂ + 1=C ₃ H ₇ Lloyd (1974) review (a) Selative and HG ₂ Lloyd (1974) review (b) Relative (a) Relative (b) Relative (b) Relative (c) Relative				value.	
Hθ ₂ + CH ₂ θ - H ₂ θ ₂ + CHθ *Lloyd (1974) review Baldwin, et al (1972) Hθ ₂ + CH ₃ θ ₂ - CH ₃ θ ₂ H + θ ₂ Demerjian et al (1972) review Hθ ₂ + C ₂ H ₄ - C ₂ H ₄ θ + Hθ γ Hθ ₂ + C ₂ H ₄ - Addition products Lloyd (1974) review Hθ ₂ + C ₂ H ₅ - H ₂ θ ₂ + C ₂ H ₅ Lloyd (1974) review Hθ ₂ + C ₂ H ₅ - H ₂ θ ₂ + T ₂ H ₃ Lloyd (1974) review Hθ ₂ + C ₃ H ₈ - H ₂ θ ₂ + T ₃ H ₇ Lloyd (1974) review Hθ ₂ + C ₃ H ₈ - H ₂ θ ₂ + T ₃ H ₇ Lloyd (1974) review (a) Relative (a) Relative (b) Relative (a) Relative (b) Relative (b) Relative (c) Relative (c) Relative (c) Relative (c) Hθ ₂ + C ₃ H ₃ + H ₂ θ ₂ + T ₃ H ₇ Lloyd (1974) review Lloyd (1974) review					low-pressure
Fig. + CH ₂ θ + H ₂ θ ₂ + CHΘ *Lloyd (1974) review Baldwin, et al (1972) Fig. + CH ₃ θ + H ₂ θ ₂ + CHΘ Fig. + CH ₃ θ ₂ + CH ₃ θ ₂ H + θ ₂ Demerjian et al (1972) review Fig. + C ₂ H ₄ + C ₂ H ₄ θ + Hθ ? Walker (1973) Fig. + C ₂ H ₄ + addition products Fig. + C ₂ H ₄ + addition products Fig. + C ₂ H ₄ + addition products Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Fig. +					
H ⁶ ₂ + CH ₂ θ - H ₂ θ ₂ + CHθ *Lloyd (1974) review Baldwin, et al (1972) T73 1.6 x 10 ⁻¹⁵ (a) Derived H ⁶ ₂ + CH ₃ θ ₂ H + θ ₂ Demerjian et al (1972) review H ⁶ ₂ + C ₂ H ₄ + C ₂ H ₄ θ + Hθ ? Walker (1973) H ⁶ ₂ + C ₂ H ₄ - addition products Lloyd (1974) review H ⁶ ₂ + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Lloyd (1974) review H ⁶ ₂ + C ₂ H ₅ + H ₂ θ ₂ + C ₂ H ₅ Lloyd (1974) review H ⁶ ₂ + C ₃ H ₅ - H ₂ θ ₂ + C ₂ H ₅ Lloyd (1974) review H ⁶ ₂ + C ₃ H ₅ - H ₂ θ ₂ + 1 - C ₃ H ₇ Eloyd (1974) review H ⁶ ₂ + C ₃ H ₅ - H ₂ θ ₂ + 1 - C ₃ H ₇ Eloyd (1974) review H ⁶ ₂ + C ₃ H ₅ - H ₂ θ ₂ + 1 - C ₃ H ₇ Eloyd (1974) review H ⁶ ₃ + C ₃ H ₅ - H ₂ θ ₂ + 1 - C ₃ H ₇ Eloyd (1974) review					eference reaction:
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H\$\text{Baldwin, et al (1972)}\$ *Lloyd (1974) review Baldwin, et al (1972) H\$\text{G}_2 + CH_3\text{G}_2 + CH_3\text{G}_2H + \theta_2\text{G}_2\text{Baldwin, et al (1972)}\$ Demerjian et al (1972) review H\$\text{G}_2 + C_2H_4 + C_2H_4\text{G} + H\text{G} ? Walker (1973) H\$\text{G}_2 + C_2H_4 + addition products}\$ Lloyd (1974) review H\$\text{G}_2 + C_2H_6 + H_2\text{G}_2 + C_2H_5 Lloyd (1974) review H\$\text{G}_2 + C_2H_6 + H_2\text{G}_2 + C_2H_5 Lloyd (1974) review H\$\text{G}_2 + C_3H_8 + H_2\text{G}_2 + i=C_3H_7 Lloyd (1974) review *300-1000 *-1.7 Lloyd (1974) review *300-1000 *-3.3					eference reaction:
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$S\theta_{3} \rightarrow \text{products}$ (1977) $S_{1} \rightarrow \text{products}$ $\frac{\lambda/nm}{200} \frac{10^{20} \times \sigma}{40.3} \frac{\lambda/nm}{200} \frac{10^{20} \times \sigma}{2.1}$ $\frac{\lambda/nm}{200} \frac{10^{20} \times \sigma}{40.3} \frac{\lambda/nm}{200} \frac{10^{20} \times \sigma}{2.1}$ $\frac{210}{200} \frac{36.3}{26.3} \frac{290}{290} \frac{1.14}{1.14}$ $\frac{220}{220} \frac{26.4}{12.9} \frac{320}{3.20} \frac{0.21}{0.38}$ $\frac{240}{270} \frac{12.9}{3.5} \frac{320}{3.5} \frac{0.04}{0.08}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{320}{3.5} \frac{0.04}{0.08}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{350}{3.5} \frac{0.04}{0.08}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{3.20}{3.5} \frac{0.04}{0.08}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{3.20}{3.5} \frac{0.04}{0.08}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{3.20}{3.5} \frac{0.04}{0.08}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{3.20}{3.4} \frac{0.04}{3.5}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{3.20}{3.4} \frac{0.04}{3.5}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{3.20}{3.4} \frac{0.04}{3.5}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{3.20}{3.5} \frac{0.04}{3.5}$ $\frac{270}{270} \frac{3.4}{3.5} \frac{3.20}{3.5} \frac{0.04}{3.5}$ $\frac{270}{3.4} \frac{3.20}{3.5} \frac{0.04}{3.5}$ $\frac{270}{3.5} \frac{0.04}{3.5} \frac{0.04}{3.5} \frac{0.04}{3.5}$	Seg - products Seg - products man, et al (1975) man, et al (1975) Mar, et al (1975) Mar, et al (1977)	S63 - products Man, et al (1975) Man, et al (1975) Man, et al (1975) Man, et al (1975) Man, et al (1977) Mar, et al (1977) Man, et al (1977	S63 - products man, et al (1975) hy - H0 + H0 (1977) (1977) 298 9.1 - 2.9 x 10 ⁻¹³ hy - H0 + H0 (1977) 200 48.3 280 2.1 200 48.3 280 2.1 210 36.4 300 0.66 220 26.4 300 0.21 220 26.4 300 0.21 220 26.4 300 0.21 220 26.4 300 0.21 220 26.4 300 0.021 220	$S\theta_3$ - products at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (a) $\frac{\lambda/nm}{48.3}$ $\frac{10^2 0}{280}$ $\frac{\lambda/nm}{2.1}$ $\frac{10^2 0}{2.0}$ $\frac{\lambda/nm}{48.3}$ $\frac{10^2 0}{2.0}$ $\frac{\lambda}{2.1}$ $\frac{\lambda/nm}{2.0}$ $\frac{10^2 0}{2.0}$ $\frac{\lambda}{2.0}$ $\frac{\lambda/nm}{48.3}$ $\frac{10^2 0}{2.0}$ $\frac{\lambda}{2.0}$ $\frac{\lambda/nm}{2.0}$ $\frac{10^2 0}{2.0}$ $\frac{\lambda}{2.0}$ $\frac{\lambda/nm}{2.0}$ $\frac{10^2 0}{2.0}$ $\frac{\lambda/nm}{2.0}$ $\frac{\lambda/nm}{2.0}$ $\frac{10^2 0}{2.0}$ $\frac{\lambda/nm}{2.0}$ $\frac{\lambda/nm}{2.0}$ $\frac{10^2 0}{2.0}$ $\frac{\lambda/nm}{2.0}$ $\frac{\lambda/nm}{2.$	S63 - products S63 - products man, et al (1975) Man, et al (1975) Man, et al (1975) A/nm	S63 - products S63 - products man, et al (1975) 1020 x g 3/0m 1020 x g 280 2.1 200 48.3 280 2.1 210 36.4 300 0.66 220 26.4 300 0.66 220 26.4 300 0.21 220 26.4 300 0.21 220 26.4 300 0.21 220 26.4 300 0.66 230 11.14 220 26.4 300 0.66 230 0.13 240 12.9 320 0.13 250 8.9 320 0.13 260 5.5 340 0.08 270 give absorption cross section in units of cm2molecule (base e). 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S63 - products S63 - products man, et al (1975) hy - H6 + H6 (1977) (1977) 298 9.1 - 2.9 x 10 ⁻¹³ 200 48.3 200 48.3 200 2.1 200 48.3 200 1.14 220 240 12.9 240 12.9 250 240 12.9 260 370 0.13 260 270 370 0.04 (a) is the absorption cross section in units of cm ² molecule (brivate communication) are in good agreement	S6 ₃ - products S6 ₃ - products man, et al (1975) hy - H6 + H6 (1977) λ/nm 10 ²⁰ x g λ/nm	S6 ₃ - products man, et al (1975) hy - H6 + H6 (1977) 298 9.1 - 2.9 x 10 ⁻¹³ hy - H6 + H6 (1977) 200 48.3 280 2.1 210 36.3 290 1.14 220 26.4 300 0.66 230 18.7 310 0.38 240 12.9 320 0.13 250 8.9 320 0.13 260 8.9 320 0.13 260 8.9 320 0.08 270 13.40 0.08 270 12.9 320 0.13 260 8.9 320 0.13 260 8.9 320 0.13 260 8.9 320 0.13 260 8.9 320 0.08 270 18.7 310 0.08 270 19.9 320 0.13 260 8.9 320 0.08 270 19.1 48.3 320 0.13 260 8.9 320 0.13 260 8.9 320 0.08 270 19.1 48.3 320 0.08 270 10.8 3.0 0.08 270 1	S63 - products S63 - products man, et al (1975) LALD ALD ALD ALD ALD ALD ALD A	S63 - products man, et al (1975) hy - H0 + H0 (1977) 298 9.1 - 2.9 x 10 ⁻¹³ hy - H0 + H0 AAnm 10 ²⁰ x q 280 2.1 200 48.3 280 2.1 210 36.3 290 1.14 220 26.4 300 0.66 230 18.7 310 0.38 240 12.9 320 0.21 250 8.9 320 0.04 (a) g is the absorption cross section in units of cm ² molecule (private communication) are in good agreement (within 10%) with unpublished results by Molina, et	S63 - products man, et al (1975) hy - H6 + H6 (1977) $\frac{\lambda / nm}{10^{20} \times 2} = \frac{10^{20} \times 2}{20} = \frac{\lambda / nm}{48.3} = \frac{10^{20} \times 2}{20} = \frac{\lambda / nm}{20} = \frac{\lambda / nm}{20} = \frac{10^{20} \times 2}{20} = \frac{\lambda / nm}{20} = $	Seg - products at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) by - HG + HG + HG	Seg - products at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) $hV + H\theta + H\theta + H\theta$ $hV + H\theta$	Seg - products at T = 670K reported in Watson's review (1977) at T = 670K reported in Watson's review (1977) $hV + H\theta + H\theta$ $hV + H\theta$	Seg - products Man, et al (1975) 10 - 2.9 x 10 ⁻¹³ 10 - 2.9 x 10 ⁻¹³ 10 - 2.0 x 10 ⁻¹³ 200	Seg - products Man, et al (1975) 10 2.0	Seg - products Man, et al (1975) 1977) 298 9.1 - 2.9 x 10 ⁻¹³ 10 ²⁰ x g 200 200 48.3 290 1.14 220 240 12.9 26.4 300 0.21 220 240 12.9 320 0.13 250 260 270 3.4 (a) σ is the absorption cross section in units of cm²molecule "(base e). These values by DeMore (private communication) are in good agreement (within noublished results by Molina, et and with results of farther common and with results of farther (1948) over common and with results of farther common and with results of farther common and with results of farther common and with results of folt, et al (1948) over common and with results of folt, et al (1948) over common and with results of farther common and with results of farth	S63 - products man, et al (1975) hy - H0 + H0 (1977) 298 9.1 - 2.9 x 10 ⁻¹³ hy - H0 + H0 AAnm 10 ²⁰ x q 280 2.1 200 48.3 280 2.1 210 36.3 290 1.14 220 26.4 300 0.66 230 18.7 310 0.38 240 12.9 320 0.21 250 8.9 320 0.04 (a) g is the absorption cross section in units of cm ² molecule (private communication) are in good agreement (within 10%) with unpublished results by Molina, et	S6 ₃ - products man, et al (1975) hy - H6 + H6 (1977) λ/nm 10 ²⁰ x 10 ⁻¹³ hy - H6 + H6 (1977) λ/nm 10 ²⁰ x 10 ⁻¹³ hy - H6 + H6 (1977) 200 48.3 200 48.3 200 10.14 200 210 26.4 200 10.20 240 250 260 260 260 270 260 260 270 27
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+ H H See reverse reaction - H + H + H + H H - H + H + H H - H + H + H H - H + H + H H - H + H H - H + H H - H + H H - H + H H - H + H H - H H - H H - H H - H H - H H - H H - H
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H + H + H H - H + H + H H - H + H H - H + H H - H + H H - H + H H - H + H H - H H - H H - H H - H H - H H - H H - H | = 1 + HCl + H on (1977) eval on (1977) eval 1 + HCl + H on (1977) eval 1 + HCl + H on (1977) eval 2 + HCl + H on (1977) eval 2 + HCl + H on (1977) eval 2 + HCl + H 2 + |
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| 1-HCl+H 1-HCl+H 1-HCl+H 200-300 3.5 x 10 ⁻¹¹ exp(-2200/T) 213-350 (5.5 ± 0.5) x 10 ⁻¹¹ exp(-2375 ± 100/T) 200-500 (2.66 ± 0.42) x 10 ⁻¹¹ exp(-230 ± 60/T) 10 - products (1977) et al (1977) 200-300 k ≤ 1 x 10 ⁻¹² exp(-4800/T) 200-300 k ≤ 1 x 10 ⁻¹² exp(-4800/T) 200-300 k ≤ 1 x 10 ⁻¹² exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 60/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 100/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 100/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 100/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 100/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 100/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 100/T) 200-300 k ≤ 1 x 10 ⁻¹³ exp(-6230 ± 100/T) 200-3 | ## # # # # # # ## ## ## ## ## ## ## ## | ## # # # # # # # # # # # # # # # # # # | - H + H + M on (1977) eval 200-300 3.5 x 10 ⁻¹ 1exp(-2290/T) t al (1977) t al (1977) t al (1977) 200-500 (2.66 ± 0.42) x 10 ⁻¹ 1exp(-275 ± 100/T) 1g - products (1977) eval 200-500 (2.66 ± 0.42) x 10 ⁻¹ 1exp(-275 ± 100/T) 200-500 (2.66 ± 0.42) x 10 ⁻¹ 1exp(-2730 ± 60/T) 1g - products 200-500 (2.66 ± 0.42) x 10 ⁻¹ 1exp(-2730 ± 60/T) 200-500 (2.66 ± 0.42) x 10 ⁻¹ 1exp(-2730 ± 60/T) 200-500 (3.7
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217 20 7.7 × 10 ⁻⁷ 2.3 × 10 ⁻⁷ 45 latit 22 2.8 × 10 ⁻⁶ 6.8 × 10 ⁻⁷ 45 latit 22 2.7 30 4.1 × 10 ⁻⁶ 6.8 × 10 ⁻⁶ 5.8 × 10 ⁻⁷ 2.3 × 10 ⁻⁶ 5.8 × 10 ⁻⁶ 5.3 × 10 ⁻⁶ 5.8 × 10 ⁻⁶ 5.3 ×		*Johnston (1974) review	217		10-7 1.5		۲. د
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227 30 1.4 x 10 5 3.5 x 10 6 solar equil 237 35 4.1 x 10 5 1.2 x 10 5 standard oz 251 40 1.1 x 10 5 1.2 x 10 5 backgro 255 45 1.1 x 10 4 4.2 x 10 5 backgro 3.5 x 10 6 5 2.7 x 10 5 backgro 3.5 x 10 6 5 5 2.7 x 10 5 backgro 3.6 x 190 32 5 m 4.9 Products probably those shown above. A 190 32 5 m in good agreement with that of Johnston and Graham (1973) Beddard, et al (1974) HNG3 + M - HG + NG2 + M HNG3 + W - HG + NG2 + M EACH - HC1 + NG3 +*NASA (1977) eval Leu, DeMore (1975) Leu, DeMore (1975) Leu, DeMore (1975) Leu, DeMore (1975) 251 40 1.4 x 10 6 1			222	ស	10-6		titude
## 237 35 4.1 x 10.5 1.2 x 10.5 251 40 7.6 x 10.5 2.7 x 10.5 2.5 4.1 x 10.5 2.5 x 10.5 2.5 2.7 x 10.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2.5 2			227		10 5 3.5	U)	quinox
#Johnston, Graham (1973) #Johnston, et al (1974) Biaume (1973) #Johnston, et al (1974) #Johnston coefficients for A = 120 min good agreement with that of Johnston and Graham (1973). #HNG3 + M - HG + NG2 + M #HNG3 + Cl - HCl + NG3 #*NASA (1977) eval Leu, DeMore (1976) #Johnston coefficient vs # # # # # # # # # # # # # # # # # # #			750		10 5 1.2	a	90000
#Johnston, Graham (1973) #Johnston, draham (1973) #Johnston, et al (1974) Biaume (1973) Beddard, et al (1974) #WG3 + M - HG + NMG2 + M #WG3 + Cl - HCl + NMG3 #*NASA (1977) eval Leu, DeMore (1976) #Johnston, Graham (1973) ##WA factor coefficient to and agreement with that of Johnston and Graham (1973). ##WA factor coefficient to a see reverse reaction ##WG3 + Cl - HCl + NMG3 ##WA factor chosen. Eact derived to fit room ##WA factor chosen. Eact derived to fit room			150		10=5		ban out
#Johnston, Graham (1973) #Johnston, et al (1974) Johnston, et al (1974) Biaume (1973) ### Products prohably those shown above. #### Absorption cross section data for for 185 < \lambda < 325 nm in good ##################################			26.5		10-4		
Johnston, et al (1974) Biaume (1973) Beddard, et al (1974) HNG3 + M - HG + NG2 + M HNG3 + M - HG + NG2 + M HNG3 + Cl - HCl + NG3 +*NASA (1977) eval Leu, DeMore (1976) Johnston (a) Products prohably those shown above. Absorption cross section data for for 185 + 1855 nm in good agreement with that of Johnston and Graham (1973). Ifigure showing extinction coefficient vs A for A - 120-170nm see reverse reaction 1.0 x 10 ⁻¹¹ exp(-2170/T) Leu, DeMore (1976) (5.8 ± 3.4) x 10 ⁻¹⁵ (a) "A factor" chosen. E _{act} derived to fit room		*Johnston, Graham (1973)		Table of absorptio	n coefficients for		
Johnston, et al (1974) Johnston, et al (1974) Blaume (1973) Blaume (1973) Beddard, et al (1974) Beddard, et al (1974) HNG3 + M - HG + NG4 + M HNG3 + Cl - HCl + NG3 +*NASA (1977) eval Leu, DeMore (1976) Johnston above. Absorption cross section data for for 185 + A = 325 nm in good agreement with that of Johnston and Graham (1973). Igure showing extinction coefficient vs A for A = 120=170 nm see reverse reaction 1.0 x 10 = 110 m				λ * 190-325nm			
Biaume (1973) Biaume (1973) Beddard, et al (1974) A for A = 120=170nm See reverse reaction BNG3 + M - HG + NG4 BNG3 + Cl - HCl + NG3 +*NASA (1977) eval Leu, DeMore (1976) 295 (6,8 ± 3.4) x 10=15 (a) "A factor" chosen. E _{act} derived to fit room		Johnston, et al (1974)		1 200 < A	315nm		(B)
House (1973) Beddard, et al (1974) Beddard, et al (1974) HNG3 + M - HG + NG2 + M HNG3 + Cl - HCl + NG3 +*NASA (1977) eval Leu, DeMore (1976) Leu, DeMore (1976) A for A = 120=170/T See reverse reaction 1.0 x 10 ⁻¹¹ exp(=2170/T) (6.8 ± 3.4) x 10 ⁻¹⁵ (a) "A factor" chosen. E _{act} derived to fit room						ve.	
Beddard, et al (1974) Beddard, et al (1974) $A = A = A = A = A = A = A = A = A = A =$		Biaume (1973)			ection data for		
Beddard, et al (1974) figure showing extinction coefficient vs λ for λ = 120=170nm λ = 120=170nm λ = 120=170/m λ =				for 185 < A < 325	nm in good		
Beddard, et al (1974) figure showing extinction coefficient vs λ for λ = 120-170nm Δ for λ = 120-170nm Δ + Δ				agreement with tha	t of Johnston and		
Beddard, et al (1974) figure showing extinction coefficient vs λ for λ = 120-170nm HNd ₃ + M + H0 + Nd ₂ + M HNd ₃ + Cl - HCl + Nd ₃ 1.0 x 10 ⁻¹¹ exp(-2170/T) 1.0 x 10 ⁻¹¹ exp(-2170/T) 1.0 x 10 ⁻¹³ exp(-2170/T) 1				Graham (1973).			
HNG ₃ + M - HG + NG ₂ + M see reverse reaction HNG ₃ + Cl - HCl + NG ₃ + $\frac{200-300}{1.0 \times 10^{-11} \exp(-2170/T)}$ +*NASA (1977) eval 295 (6.8 \pm 3.4) x 10 ⁻¹⁵ Leu, DeMore (1976) 295 (6.8 \pm 3.4) x 10 ⁻¹⁵ (a) A factor chosen. E _{act} derived to fit room		Beddard, et al (1974)			inction coefficient	s »	
HN63 + M \rightarrow H6 + N62 + M HN63 + Cl \rightarrow HCl + N63 +*NASA (1977) eval				λ for λ * 120-170n	E		
200-300 1.0 x 10 ⁻¹¹ exp(-2170/T) ±0.6 at 295 (6.8 ± 3.4) x 10 ⁻¹⁵ (a) A factor chosen. E _{act} derived to fit room	10			see reverse reacti	oo		
295 (6.8 ± 3.4) x 10 15 (a) "A factor" chosen. Eact derived to fit room		+*NASA (1977) evel	200-300	1.0 x 10-11exp(-21	70/T)		0K (a)
(a) "A factor" chosen. Eact derived to fit room		Leu, DeMore (1976)	295	(6.8 ± 3.4) x 10 ⁻¹		,	
				(a) "A factor" ch	osen. Eact derived	to fit room	

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	Constant Notes and Ite-1s-1 Reliability of log k			₹0*		\$0/T)								le 1s = 1 +0.1		40°0		t 250/T) cm ⁶ molecule s=1 M = Ar		$0.9) \times 10^{-11} \exp(0 \pm 120/T)$ ± 0.1															77/T) ±0.3		(a) (T) (a)	$(7.93 \pm 1.53) \times 10^{-1}^{2} \exp(-1273 \pm 51/T)$	² exp(-1260 ± 35/T) (b)	(p(-608/T)	·12exp(-1229 * 27/T)	197 400	
	Temp. Reaction Rate Constant Range/K k/cm ³ molecule ¹ s ⁻¹			298 6.5 x 10 ⁻¹³		230-2600 2.8 x 10 ⁻¹² exp(-2050/T)		300 < 3 x 10 15	2×10^{-13}	300 8.3 ± 6.7 x 10 ⁻¹⁶		300 2 * 1.2 x 10"15		300 3 x 10 13 cm molecule 1s 1		295 1.2 x 10 ⁻¹¹		200=500 6 x 10 ⁻³⁴ exp(900 ±		300=588 (5.9 ± 0.9) x 10 ⁻¹			kg = 1.6 x 10 10	1.1 x 1	- 1.5	k_/k, = 108	258 Kg/kh = 15	3	300 6.8 x 10-13		258 3 ± 0.5 x 10-11		298 K >> 3 x 10=14		224-273 1.68 x 10 ⁻¹² exp(-607/T)		200-300 7.3 x 10 ⁻¹² exp(-1269/T)	218-322 (7.93 * 1.53) x 10	218-401 (7.94 ± 0.7) x 10	200-500 5.44 x 10-19T2.50e.	200=299 (6.51 ± 0.79) x 10	200-500 8.6 x 10-18 _T 2.11 _{ex}	•
	Reaction/Reference * * Preferred Value + * NASA (1977) eval		$S + CS_2 + S_2 + CS$	Baulch, et al (1976) review	s + cas - ca + s2	Baulch, et al (1976) review	$S\theta + S\theta + S\theta_2 + S \text{ or } (S\theta)_2$	Schofield (1973) review		Chung, Calvert, Bottenheim (1975)	se + seg → 2seg2	Chung, Calvert, Bottenheim (1975)	$S\theta_2 + CH_3 (+M) + CH_3 S\theta_2 (+M)$	James, et al (1973)	HS + HS + HS + SH	Baulch, et al (1976) review	$cl + cl + M - cl_2 + M$	*Watson (1977) review	c1 + 6c16 - 2c16	+*Watson (1977) review	$cl + cl\theta\theta - cl_2 + \theta_2$ (a)	- 2Clθ (b)	+*NASA (1977) eval		Johnston, et al (1969)		Nicholas, Norrish (1968)	c1 + c124 + c12 + c18	*Watson (1977) review	cl + NGCl - NG + Cl ₂	+*Watson (1977) review	cl + Nø2cl - Nø2 + cl2	Watson (1977) review	cl * Negcl * products	+*Kurylo, Manning (1977)	$cl + cB_4 - Hcl + cH_3$	+*Watson (1977) review	Manning, Kurylo (1977)	Watson, et al (1976)	Whytock, et al (1977)		Zahniser, et al (1978)	
December 1977	No.		26a, 34b		26a, 34c		27,27				27,29		28,49M		31,31		35,35M		35,37		35,37							35,44a		35,42		35,43		35,43a		35,56							

	Reaction/Reference	Temp.	Reaction Rate Constant	Notes and
	* = Preferred Value	Range/K	k/cm3molecule 1s-1	Reliability of
No.	+ = NASA (1977) eval			log k
	Fettis, Knox (1964) Clyne, Walker (1973)	300-686	4 x 10 ⁻¹¹ exp(-1930/T) 5.1 x 10 ⁻¹¹ exp(-1790/T) (a) Based on four direct 1976, 1977 studies listed immediately below. Uncertainty in log k(230K) is *0.12 and -0.36 (b) Value changed subsequent to publication to allow for effect of small C ₂ H ₆ impurity see Watson's review (1977)	udies Inty ation Impurity
8 2 . 2 .	Cl + C ₂ H ₆ - HCl + C ₂ H ₅ Manning, Kurylo (1977)	88 £ - 88	$(7.29 \pm 1.23) \times 10^{-11} \exp(-60 \pm 44/T)$	
36, hv	cle + hv - cl + e *Watson (1977) review		absorption cross section data 225 < A < 300 nm	
36,36	$Cl\theta + Cl\theta + Cl + Cl\theta\theta (a)$ $- Cl2 + \theta2 (b)$ $- \theta Cl\theta + Cl (c)$			
	+*NASA (1977) eval	200-300	kg = 1 x 10 ⁻¹² exp(-1238/T)	*0.2 at 230K (a)
				*1 at 230K *1 at 230K b pressure sec
36, 36Br	Cl6 + Br6 - Br + 6Cl6 (a) - Br + Cl66 (b) +*Watson (1977) review		k = (6.7 ± 1.0) x 10°12	#0.35 at 230K
36,45	10 + 60 + 60 + 61		k _b = (6.7 ± 1.0) × 10 ⁻¹²	
	+*NASA (1977) eval	200-300	$k \le 1 \times 10^{-1} \text{exp}(-3700/T)$	#2 at 230K (a) fitted to upper limit Watson's review (1977)
36,56	Cle + CH4 - products			
	+*NASA (1977) eval	200-300	k < 1 x 10 = 12 exp(=3700/T) (a) "A factor" chosen. Eact fitted to upper limit at T = 670K reported in Watson's review (1977)	#2 at 230K (a) upper limit eview (1977)
36,57	Cle + C2H4 - products			
90	Walker (1972) Cl0 + C.H products	670	k < 5 x 10°16 (a) As quoted by Watson (1977) review.	(a)
	Walker (1972)	670	k < 5 x 10-16 (a) As quoted by Watson (1977) review.	(e)
6Br. 36B	36Br, 36Br Bre + Bre - 2Br + 62			
	+*NASA (1977) eval	200-300	2.9 x 10-11 exp(-450/T)	#0.36 at 230K
	Clyne, Watson (1975)	8 6 6	6.4 x 10-12	
	Clyne, cruse (17)	C 4 2		

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Notes and Reliability of log k						
Reaction Rate Constant k/cm³molecule°is=1	Table of values of rate constant as a function of altitude.	absorption cross section data 225 4 4 280 nm Abs. cross section data 150 4 4 4 80nm	cross section data \$\lambda < 220 nm section data 290 < \lambda < \lambda \l	Table of absorption cross section values for λ = 190-400nm Absorption cross section data for λ = 190-400nm Absorption cross section data	for λ = 235=400nm Table of absorption cross section values for λ = 186=460nm. Also table of solar photodissociation coefficients Data also tabulated in reviews by Watson (1977) and by Molina (1977). Molina's review also discusses quantum yield data	absorption cross section data 240 4 4 6 4 6 1 2 $^$
Temp. Rea Range∕K k	Table of function	absorption 225 < Abs. cross	H	Table of absorptifor λ = 190=400nm Absorption cross for λ = 190=400nm Absorption cross	for λ = 2; Table of for λ = 1, photodiss tabulated and by Mo also disc	absorption 240 4 see CH ₃ 0 + 285 290 295 300 310 315
Reaction/Reference * = Preferred Value + = NASA (1977) eval	$Cl\theta\theta + M \rightarrow Cl + \theta_2 + M$ Watson (1977) review $Cl\theta\theta + h\nu \rightarrow Cl\theta + \theta$ Watson (1977) review	watson (1977) review $\theta C L \theta + h \nu \rightarrow C L \theta + \theta$ Watson (1977) review	HCl + hv + H + Cl Watson (1977) review HØCl + hv + products Watson (1977) review NGCl + hv + products	Molina (1977) review ClN6 ₂ + hv Molina (1977) review Cl6N6 + hv Molina (1977)	Nøgct + hv Rowland, Spencer, Molina (1976)	Cd + hv + 2Cl Watson (1977) review Cd + CH ₃ + CH ₂ θ + hv + CH ₂ θ [*] + H + HCθ (1) This survey (1978)
December 1977	37° M	37, hv	39, hv 40, hv	43, hv	4 3a, hv	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4

December 1977	Re	Temp.	Reaction Rate Constant		
No.	* * Preferred Value + * NASA (1977) eval	Range/K	k/cm ² molecule 1s	Reliability log k	fo
			335 0.17 1 340 0.02 0.64 Tentative recommendation based principally on reported by Horowitz and Calvert (1978a) and by Moortgat, et al (1978). Also considers results	335 0.17 1 340 0.02 0.64 Tentative recommendation based principally on results reported by Horowitz and Calvert (1978a) and by Moortgat, et al (1978). Also considers results	
	-		reported in Clark, Moore and Nogar (1977), Horowil and Calvert (1978b), Houston and Moore (1976), Lev and Lee (1977), Lewis, Tang and Lee (1976) and Marling (1977). Apparent quantum yield values are slightly higher presence of 6%. Effect is assumed here to be due	reported in Clark, Moore and Nogar (1977), Horowitz and Calvert (1978b), Houston and Moore (1976), Lewis and Lee (1977), Lewis, Tang and Lee (1976) and Marling (1977). Apparent quantum yield values are slightly higher in presence of 6. Effect is assumed here to be due to	
	Calvert, et al (1972)		secondary reactions. <u>A/mm</u> 10 ²⁰ x g 290 3.18 300 3.25		
			310 2.34 350 0 2.34 360 0 (a) \(\text{is the value of the absorption cross} \) section averaged for 10nm bands. See McQuigg, Calvert (1969) for figure of of absn. coeff. vs wave length. Also Miller and Lee (1977) for higher resol spectra from which absorption cross se	3.14 350 0.84 2.34 360 0.18 of is the value of the absorption cross section averaged for 10nm bands. See McQuigg, Calvert (1969) for figure of of absn. coeff. vs wave length. Also see Miller and Lee (1977) for higher resolution spectra from which absorption cross section	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	$CH_3\theta + \theta_2 - CH_2\theta + H\theta_2$ (1) $CH_3\theta + N\theta - CH_3\theta N\theta$ (2a) $- CH_2\theta + HN\theta$ (2b) $CH_3\theta + N\theta_2 - CH_3\theta N\theta_2$ (3a) $- CH_2\theta + CH_2\theta N\theta_2$ (3b) $- CH_2\theta + CH_2\theta N\theta_2$ (3b)			· D	
	*Heicklen (1973)	258	$k_1 \sim 3 \times 10^{-18}$ $\sim 1.6 \times 10^{-13} \exp(-3300/T)$ $k_2 \sim 8 \times 10^{-14}$	0/T)	
		& 0 0 0		ratio probably is smaller at 220K	is XOX
		0	K2a/K3a 1.1 1.8 K3a/K3 0.9 #0.1 K3./K. 0.1 #0.01	* k3a/k3b	r. d c c
	Demerjian, et al (1974) review	298-423	5 x 3 6 x 10	2000400F	000%

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Batt, Mculloch, Mine (1975) Batt, Mculloch, Mine (1975) Batter, et al (1977) Batter,	December 1977 No.	Reaction/Reference * * Preferred Value + * NASA (1977) eval	Temp. Range/K	Reaction Rate Constant k/cm molecule 1s 1	Notes and Reliability of log k
ne (1975) 393-473				x 4.2 x 10 ⁻¹³ exp(-3000/T) adjusted to fit C ₄ H ₁₀ /N ⁶ x simulation studies k _{2a} 1.7 x 10 ⁻¹³ k _{2b} /k _{2a} 0.17 k _{3a} 3.3 x 10 ⁻¹³ k _{3h} /k _{3n} 0.1	
(a) (b) (c) (c) (c) (d) (e) (e) (e) (e) (e) (e) (e) (e) (e) (e		McCulloch, Milne (1975)	393-473	1 1	4 °0 4 5 °0 5
*** **********************************	- (4	a) + 0/2 (c)	396-442	U)	
300		LO.	300	κ _α /κ = 0.43 κ _b /κ = 0.50 κ _c /κ = 0.07	
+ NØ (a) (b) + H o (c) + H o (d) 298 + k _b /k 0.76 ±0.02, A 366nm 298 + k _b /k 0.22 ± 40.04, A 366nm (k _c o k _d)/k 0.02, A 366nm + k k v _b v _c v _c Absorption cross section data for 174 o Anm o 220 Low temperature absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data Absorption cross section data Absorption cross section data for 174 o Anm o 230 Low temperature absorption cross section data Absorption cross section data	W	8 (1977)	300	1.6 4	
(1973) review 298	2	• Ne • H			
Absorption cross section data for 174 < λ/nm < 220 Low temperature absorption cross sect 77) review 77) review 77) review 77) review 75) review 76 174 < λ/nm < 230. 77) review 76 174 < λ/nm < 236. 77) review 77) review 78 6ction data 797) review 797) review 798 797)		klen (1973) review	298 298 298	- 0.76 ±0.02, X = 3 - 0.24 ±0.04, X = 3 + kd / k < 0.02, X = k, + k,	
Tabulated values of absorption cross for 170 to 174 to 177) review to 177 to 177) review to 177 to 177) review to 177 to 177) to 177 to	(4 5	2 + hv n (1977) review a (1977) review		Absorption cross section data for 174 < \lambda/nm < 220 Low temperature absorption cross section data	
Absorption cross to 174 < A/nm < see Watson's revi	200	* hv n (1977) review a (1977) review			
	* L	• hv n (1977) review		Absorption cross section data for 174 < \lambda/nm < 238.	

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APPENDIX 1.

Chemical Thermodynamic Properties of Selected Molecular Species

E. S. Domalski, D. Garvin, and D. D. Wagman

Two tables are provided showing chemical thermodynamic properties of selected molecular species of interest in stratospheric chemistry. In these tables there are sufficient data for the usual calculations of heats of reaction and equilibria.

The first table lists enthalpy and Gibbs energy of formation, entropy and heat capacity data. The information was extracted from "Selected Values of Chemical Thermodynamic Properties" (D. D. Wagman, et al, NBS Technical Note 270-3, January 1968) except as indicated in the Notes. The thermodynamic properties tabluated are:

- 1. enthalpy of formation at OK and 298.15K,
- 2. Gibbs energy of formation at 298.15K,
- 3. enthalpy increment between OK and 298.15K,
- 4. entropy at 298.15K,
- 5. heat capacity at constant pressure at 298.15K.

The values given for the heats of formation are based on experimental thermodynamic and spectroscopic measurements except where otherwise indicated; the values of S°, C $_{\rm p}$ ° and H° $_{\rm 298}$ –H° for gaseous species were calculated by standard statistical-mechanical equations, using corrections for vibrational anharmonicities, rotational stretching, and rotation-vibration interactions where these data were available.

The second table presents bond dissociation energies or bond strengths. These usually are the enthalpies of simple bond scission reactions. However, there are some cases in which there is a substantial contribution from rearrangement of electronic structure in the products (reducing the bond energy).

The values given here for some molecules may differ slightly from values adopted by the CODATA Task Group on Key Values for Thermodynamics (see CODATA Bulletin 17, published by the International Council of Scientific Unions Committee on Data for Science and Technology, January 1976). These differences will have no significant effect on the enthalpies or free energies of reaction calculated from the tables.

CHEMICAL THERMODYNAMIC PROPERTIES OF SELECTED MOLECULAR SPECIES

National Bureau of Standards

Washington, D. C.

			0,4H√	∆H£°	79T	н ² 98 - н°	ę.	్టి
E Comment	State	Formula	0 °K		29	298.15°K (25°C	(:	
r ormula and Description	חומוה	Weight		kcal/mol	nol		cal/de	cal/deg mol
0 oxygen, atomic	50	15.9994	58.983	59,553	55,389	1.607	38.467	5.237
0(¹ p)	60	15.9994	104.34	104.78		1.481		
0.1s)	50	15.9994	155.60	156.04		1.481		
0_{γ} oxygen, molecular, $({}^{3}E_{g}^{-})$	50	31.9988	0	0	0	2.0746	49.003	7.016
	50	31,9988	22.54	22.54				
$0_2(^1\Sigma)$	50	31,9988	37.51	37.51				
0 ₃ ázone	60	47.9982	34.74	34.1	39.0	2.4736	57.08	9.37
H hydrogen, atomic	80	1,0080	51.633	52.103	48.588	1,481	27.391	4.9679
H ₂ hydrogen, molecular	50	2.0159	0	0	0	2.0238	31,208	6.889
OH hydroxy1	60	17.0074	9.25	9.31	8.18	2.1070	43.890	7.143
HO ₂ hydroperoxy1	60	33.0068	1.2+2	0.5+2	3.4	2.39	54.73	8.34
H ₂ 0 water	90	18,0153	-57.102	-57.796	-54.634	2.3667	45.104	8.025
H ₂ 0 ₂ hydrogen peroxide	60	34.0147	-31,08	-32.58	-25.24	2.594	55.6	10.3
N nitrogen, atomic	60	14.0067	112,534	112.979	108.883	1.481	36,622	4.968
N ₂ nitrogen, molecular	60	28.0134	0	0	0	2.072	45.77	6.961
NO nitric oxide	60	30,0061	21,45	21.57	20.69	2.197	50.347	7.133
NO ₂ nitrogen dioxide	60	46.0055	8.60	7.93	12.26	2,438	57.35	8.89
NO ₃ nitrogen trioxide	60	62.008	18.5	17.0	27.7	2.62	4.09	11.2
N_2^{0} nitrous oxide	50	44.0128	20,435	19.61	24.90	2,284	52.52	9.19
$^{ m N}_2{}^0{}_4$ dinitrogen tetroxide	60	92.0110	67.4	2.19	23,38	3.918	72.70	18.47

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(3)

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Substance			ΩH£0	, ΣΗΣ	^Gf°	н298 - но	ຶ້ນ	c _p
	Chat	Formula	0 °K		367	298.15°K (25°C)		
Formula and Description	State	Weight		kcal/mol	lol		cal/deg mol	g mol
N ₂ O ₅ dinitrogen pentowide	60	108,0104	5.7	2.7	27.5	4.237	85.0	20.2
NH imino (imidogen)	ьо	15.0147	82.	82.	9.08	2.060	43.29	6.97
NH, amino	60	16.0226	46.2	45.5	47.8	2.37	46.51	8.02
Z NH ₂ ammonia	60	17.0306	-9,31	-10.98	-3.93	2.40	46.05	8.38
HNO nitroxyl hydride	60	31.0142	24.5	23.8	26.859	2.387	52.729	8.279
HNO, cis, nitrous acid	80	47.0135	-17.12	-18.64	-10.27	2,608	59.43	10.70
trans, nitrous acid	60	47.0135	-17.68	-19.15	-10.82	2.652	59.54	11.01
cis-trans mixture, equil.	60	47.0135		-19.0	-11.0		60.7	10.9
HNO ₃ nitric acid	60	63.0129	-29.94	-32.28	-17.87	2.815	63.64	12.75
S sulfur, rhombic	v	32,064	0	0	0	1.054	7.60	5.41
	60	32.064	65.7	66.20	56.52	1.591	40.085	5.658
SO monosulfur monoxide	60	48.0634	1.2	1.2	-5.0	2.087	53.02	7.21
SO, sulfur dioxide	60	64,0628	-70,33	-70.94	-71.74	2.521	59.30	9.53
SO ₃ sulfur trioxide	U	80.0622		-108.63	-88.19		12.5	
n	liq	80,0622		-105.41	-88.04		22.85	
	60	80.0622	-93.21	-94.58	-88.69	2.796	61,34	12.11
H ₂ SO _k sulfuric acid	U	98.0775	-194.069					
,	liq	98.0775		-194.548	-164.938	6.748	37,501	33.20
S,0 disulfur monoxide	60	80.1274				2.66	63.8	10.5
HS sulfur monohydride	60	33.0720	33.1	33.3	26.3	2.22	46.73	7.76
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(29) (4) (30) (3)

(30) (32) (30) (2)

National Bureau of Standards

Washington, D. C.

Enthalpy an	d Gibbs	Energy of	Formation;	Enthalpy and Gibbs Energy of Formation; Entropy and Heat Capacity	d Heat Capa	city			
Substance			ΩH£0	, JH∇	° j∂∆	Н298 - Н0	ီ	°G	
£	Ctate	Formula	0 °K		367	298.15 °K (25 °C	(
Formula and Description	State	Weight		kcal/mol	lot		cal/deg mol	g mol	
H,S hydrogen sulfide	60	34.0799	-4.232	-4.93	-8.02	2.379	49.16	8.18	
2 C graphite, Acheson spectroscopic	υ	12.0112	0	0	0	0.251	1.372	2,038	
CO carbon monoxide	60	28,0106	-27.199	-26,416	-32.780	2.0716	47.219	6:63	
CO, carbon dioxide	60	44.0100	-93,963	-94.051	-94.254	2,2378	51.06	8.87	
CH, methy1	60	15.0351	35.6	34.8	35.3	2,49	46.38	9.25	(3)
CH, methane	60	16.0430	-15.970	-17.88	-12.13	2,388	44.492	8,439	
HCO formy1	60	29.0185	8.9	0.6	5.36	2.386	53.68	8.26	(8)
HCHO formaldehyde	60	30,0265	-25,03	-25.95	-24.51	2.394	52.26	8.46	(9)
CH ₂ O methoxy	60	31.0345	5.8	3.9	6.4	2.41	64.2	8.9	(7.) (24)
CH ₂ O, methylperoxyl	60	47.0339		6.7					(8)
CH ₂ 00H methyl hydroperoxide	60	48.0347		-30.8	-17.4		6.79	15.	(6)
CH ₂ NO, nitromethane	60	61.0406	-14.546	-17.86	-1.65	3.083	69.59	13.70	
CH ₂ ONO methyl nitrite	60	61.0406	-13.5	-16.5	-1.5	3.36	69.7	16.5	(10)(24)
CH ₂ NO ₂ methyl nitrate	60	77.0400	-25.9	-29.8	7.6-	3.55	76.1	16.1	(11, 12)(24)
$^{\rm COCl}_2$ phosgene	60	98.9166	-52.195	-52.61	-49.20	3.067	67.74	13.78	(13)
CC-san-MACOSII	_								
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SELECTED VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES - SERIES

5.220 16.25 8.23 12.58 10.03 17.57 23.29 23.14 12.37 10.50 15.27 10.41 13:7 ن 10.9 12.7 cal/deg mol o da Washington, D. 39.457 74.12 59.16 70.56 61.36 52.45 54.85 70.42 53.78 48.00 63.80 64.51 59.8 64.5 9.69 ŝ 298.15°K (25°C) H298 - 116 2.580 2.525 2.856 3.237 3.512 4.645 4.276 2.819 3.529 1.499 2.278 2.392 3.01 Enthalpy and Gibbs Energy of Formation; Entropy and Heat Capacity 25.173 0g€° -51.08 -30.31 23.68 50.00 16.28 99.7-15.00 -5.81 -3.97 -4.91 -3.0 28.8 -11.6 32.0 kcal/mol ΔH£° 28.992 -39.72 -60.07 54.19 12.49 -20.04 4.88 -25.02 -30.03 -32.07 24.47 24.5 -111.4 -5.8 25.7 ΩH£00 0 °K 54.324 -16.323 8.467 -23.552 -25.223 14.515 28.59 -19.684 25.09 24.33 -10.66 -37.14 -57.93 78.4986 58.1248 42.0376 44.0536 30.0701 58.1248 946.0976 67.4518 Formula 42.0816 51.4524 28.0542 43.0456 Weight 26.0382 35.453 29.0627 State ы 60 60 ٨n ы ы ы 60 60 ы ಹ 60 60 60 Formula and Description Substance National Bureau of Standards ${\rm C10}_2$ chlorine dioxide (sym.) CH3COC1 acety1 chloride C10 chlorine monoxide CH₃CO acetyl radical Cl chlorine, atomic CH₃CHO acetaldehyde IISCOMM-NBS-DC C_2H_5 ethyl radical C4H10 isobutane C3H6 propylene C_4H_{10} n-butane C_2H_2 acetylene C_2H_4 ethylene C3Hg propane CH₂CO ketene C_2H_6 ethane Table

(15,16) (15,16) (15,16)

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SELECTED VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES - SERITS I

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. ლ 3 3 3 3 (33) (22) (23) (21) (31)18.65 14.59 15.99 19.93 8.104 11.48 17.31 96.9 8.88 10.68 20.56 12.71 11.0 cal/deg mol co, 949.44 53.288 64.07 62.52 65.02 78.21 62.45 74.02 56.54 68.17 71.91 74.00 63.0 ŝ 298.15°K (25°C) eo H H298 - 1 2.066 2.440 2.716 2.915 2.806 3.838 4.120 2.193 3.553 3.043 3.294 4.16 2.78 Enthalpy and Gibbs Energy of Formation; Entropy and Heat Capacity -12.83-212.37 -59.6 ^G£° -159.5 -108.2 -22.777 15.77 -15.7 13.0 25.1 23.3 0 kcal/mol -223.04 -117.5 -22.94 -22.062 0.69-OHE. -169.2 12.36 6.28 19.20 3.0 21,3 -18.7 37 -22.020 4.29 19.62 0 °K 12.81 ∆H£0° -68.24 -22.42 -18.0 -221,61 -168.0 21.7 -116.5 0 Formula 36.4610 88.0048 120.9140 153.8232 67,4518 83.4512 52.4604 65,4591 81.4585 86.9054 134.9036 104.4594 137.3686 Weight 97.458 70.906 State ы 60 60 ಶು ಶ ಹ 60 50 ಶಾ ы ы 50 60 ಹ 60 Formula and Description Substance ${\tt CF}_2{\tt Cl}_2$ dichlorodifluoromethane ${\rm C10}_2$ chlorine dioxide (unsym.) CC13F trichlorofluoromethane CC1F₃ chlorotrifluoromethane ${\rm CC1}_4$ carbon tetrachloride ${\rm Cl}_2{}^0{}_4$ chlorine perchlorate CF_4 carbon tetrafluoride Cl,0 dichlorine monoxide Cl₂ chlorine, molecular NO₃Cl chlorine nitrate NOC1 nitrosyl chloride ClO3 chlorine trioxide HOC1 hypochlorous acid NO₂Cl nitryl chloride HCl hydrogen chloride USCOMM-NBS-DC Table

25, 26)

SELECTED VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES - SURJES I

National Bureau of Standards							Washington,	D. C.	_
Enthalpy an Table	nd Gibbs	Energy of	Formation	ı; Entropy aı	Enthalpy and Gibbs Energy of Formation; Entropy and Heat Capacity	acity			
Substance			О́эн⊽	°3H∆	^55∆	Н298 - н₀	္စိ	°ပို	
To continue of the continue of	State	Formula	0 °K		29:	298.15 °K (25°C)			
r ormula and Description	חומור	Weight		kcal/mol	mol		cal/de	cal/deg mol	
CH ₃ Cl methyl chloride	60	50,4881	-17.69	-19.59	-13.98	2.489	55.99	9.73	(3,
$^{ m CH}_2{}^{ m Cl}_2$ methylene dichloride	60	84.9331	-21.19	-22.83	-16.49	2.830	64.57	12.16	(3,
CHCl ₃ chloroform	60	119.3781	-23.49	-24.66	-16.83	3,383	70.63	15.63	(3,
${ m CF}_3$ trifluoromethyl radical	60	69.0064	-111.7	-112.4	-109.21	2.754	63.33	11.90	(3)
${\sf CC1}_3$ trichloromethyl radical	60	118.3702	19.15	19.	22.09	3.392	70.92	15.21	(3)
C_2Gl_4 tetrachloroethylene	60	165.8343	-2.83	-2.97	5.15	4.759	82.05	22.84	3
$c_2^{ m HCl}_3$ trichloroethylene	60	131.3893	-1.032	-1.86	4.31	3.975	77.6	19.18	
CH ₃ CC1 ₃	60	133,4052	-34.65	-34.01	-18.21	4.30	76.49	22.07	(28)
1,1,1-trichloroethane									
(methyl chloroform)									
USCOMM -NBS-DC									

27) 25) 25)

Notes

- 1. Hampson, R. F. et al, J. Phys. Chem. Ref. Data $\underline{2}$, 267-312 (1973) [Data sheet on O_3 + hv (u.v.)] p. 303.
- Contributions of the higher electronic states of molecular oxygen to the enthalpy, entropy, and heat capacity at 298 K are insignificant.
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- 5. NBS Report 10904, 1 July 1972, pp. 239-307.
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- 7. Data obtained from Benson and O'Neal ("Kinetic Data on Gas

 Phase Unimolecular Reactions", NSRDS-NBS-21, Feb 1970, page 55).
- 8. Heat formation value from S. W. Benson "Thermochemical Kinetics" Second Edition, John Wiley and Sons (1976).
- 9. Values for ΔHf°, S°, and Cp° at 298.15 K were calculated using the group additivity method described by Benson and O'Neal ("Kinetic Data on Gas Phase Unimolecular Reactions", NSRDS-NBS-21, Feb. 1970, pp. 40-42).

- The value for ΔHf° [CH₃0NO(g)] = -16.5 kcal mol⁻¹ was derived from the combustion data of Geiseler and Thierfelder (Z. physik. Chem., N. F., 29, 248-257 (1961)), and the equilibrium data of Leermakers and Ramsperger (J. Am. Chem. Soc. 54, 1837-1845 (1932)) for: CH₃OH(g) + NOCl(g) = CH₃ONO(g) + HCl(g).
- 11. The value for $\triangle Hf^{\circ}$ ($CH_3ONO_2(g)$) = -29.8 kcal mol⁻¹ was derived from the work of Ray and Ogg (J. Phys. Chem. <u>63</u>, 1522-1523 (1959)) on the enthalpy of reaction of N_2O_5 with CH_3ONO .
- 12. We have chosen S° [CH₃0N0₂(g)] = 76.1 cal mol⁻¹K⁻¹ based upon low temperature thermal data of Gray and Smith (J. Chem. Soc. 1953, 2380-2385). Calculations from microwave studies by Dixon and Wilson (J. Chem. Phys. 35, 191-198 (1961)) give S° = 72.15 cal mol⁻¹K⁻¹.
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- 23. The spectroscopic data of K. O. Christe, C. J. Schack and E. C. Curtis, Inorg. Chem. <u>10</u>, 1589 (1971) were used.
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Bond Dissociation Energies, D_{0}^{0} at 0 K Calculated from heats of formation in the accompanying table

Reaction	kJ/mo1	kcal/mol	Note
o ₂ → 20	493.59±0.4	117.97±0.1	
$0_3 \rightarrow 0_2 + 0$	101.4±2.1	24.24±0.5	
Н ₂ → 2Н	432.00±0.04	103.25±0.01	
HO → H + O	423.8±2.1	101.3±0.5	
HO ₂ → HO + O	230±8	67±2	
→ H + O ₂	210±8	50±2	
H ₂ O → HO + H	493.7±0.8	118.0±0.2	
H ₂ O ₂ → 2HO	207.1±2.1	49.5±0.5	
H ₂ O ₂ → H + HO ₂	350±8	84±2	
$N_2 \rightarrow N + N$	941.69±0.04	225.07±0.01	
$NO \rightarrow N + O$	627.9	150.1	
$NO_2 \rightarrow NO + O$	300.5	71.83	
$NO_3 \rightarrow NO_2 + O$	205±21	49±5	
$N_2O \rightarrow N + NO$	474.9±4	113.5±1	
\rightarrow N ₂ + O	161.3	38.58	
$N_2O_3 \rightarrow NO + NO_2$	35.1±0.8	8.4±0.2	
$N_2O_4 \rightarrow NO_2 + NO_2$	53.2	12.7	
$N_2^{\circ}_5 \rightarrow N_2 + N_3$	89.5	21.4	
HNO → H + NO	203	48.6	
→ NH + O	487	116.5	
$trans-HNO_2 \rightarrow HO + NO$	202	48.4	
$HNO_3 \rightarrow HO + NO_2$	200	47.8	
$NH \rightarrow H + N$	343	82	

Bond Dissociation Energies, $D_{\mbox{\scriptsize o}}^{\mbox{\scriptsize o}}$ at 0 K Calculated from heats of formation in the accompanying table

Reaction	kJ/mol	kcal/mol	Note
$NH_2 \rightarrow H + HN$	366	87.4	
$NH_3 \rightarrow NH_2 + H$	448	107	
CO → C + O	1071.94±0.4	256.2±0.1	
$co_2 \rightarrow co + o$	525.9±0.4	125.7±0.1	
CHO → CO + H	70	16.7	(1)
CH ₂ O → CHO + H	364	87	(1)
$CH_3O \rightarrow CH_3 + O$	378	90.4	(1)
\rightarrow H + H ₂ CO	93	22	(1)
сн ₃ о ₂ → сн ₃ о + о	237	56.8	(1)
\rightarrow CH ₃ + O ₂	118	28.1	(1)
$CH_4 \rightarrow CH_3 + H$	432	103.2	
сн ₃ оон → сн ₃ о + но	184.	44.0	(1)
\rightarrow CH ₃ + HO ₂	276±8	66±2	(1)
$CH_3ONO \rightarrow CH_3 + NO_2$	248	59.2	(1)
$CH_3NO_2 \rightarrow CH_3 + NO_2$	254	60.6	(1)
CH ₃ ONO ₂ → CH ₃ O + NO ₂	174	41.6	(1)
\rightarrow CH ₃ + NO ₃	341	81.6	(1)
$SO \rightarrow S + O$	515.4±8	123.2±2	
so ₂ → so + o	547.3±8	130.8±2.0	
$so_3 \rightarrow so_2 + o$	342.7±4	81.9±1	

Note 1. Calculated for T = 298K

APPENDIX 2. CONVERSION TABLES EQUIVALENT SECOND ORDER RATE CONSTANTS

A	cm mol -1 -1	3 -1 -1 dm mol s	3 -1 -1 m mol -1 s	cm molecule -1 -1	(mm Hg) -1 -1	atm 1s -1	ppm-1min-1	m ² kN ⁻¹ s ⁻¹
1 cm mo1 1s =	1	10-3	10-6	1.66 × 10 ⁻²⁴	1.604 × 10 ⁻⁵ r ⁻¹	1.219 x 10 ⁻² T ⁻¹	2.453 x 10 ⁻⁹	1.203 × 10 ⁻⁴ T ⁻¹
1 dm mo1 1s =	103	1	10-3	1.66 × 10 ⁻²¹	1.604 × 10 ⁻² T ⁻¹	12.19 T ⁻¹	2.453 × 10 ⁻⁶	1.203 × 10 ⁻¹ T ⁻¹
1 m 3mol - 1 = 1	106	103	1	1.66 × 10 ⁻¹⁸	16.04 T ⁻¹	1.219 x 10 ⁴ T ⁻¹	2.453 × 10 ⁻³	120.3 T ⁻¹
1 cm molecule 1 s 1 =	6.023 × 10 ²³	6.023 × 10 ²⁰	6.023 × 10 ¹⁷	1	9.658 × 10 ¹⁸ r ⁻¹	7.34 x 10 ²¹ T ⁻¹	1.478 × 10 ¹⁵	7.244 × 10 ¹⁹ T ⁻¹
1 (mm Hg) $^{-1}s^{-1} =$	6.236 × 10 ⁴ T	62,36 Т	6.236 × 10 ⁻² T	1.035 × 10 ⁻¹⁹ T	1	760	4.56 × 10 ⁻²	7.500
1 atm 1s = 1	82.06 T	8.206 × 10 ⁻² T	8.206 × 10 ⁻⁵ T	1.362 × 10 ⁻²² T	1.316 × 10 ⁻³	1	6 x 10 ⁻⁵	9.869 × 10 ⁻³
<pre>l ppm -1 min = at 298K, l atm. total pressure</pre>	4.077 × 10 ⁸	4.077 × 10 ⁵	407.7	6.76 × 10 ⁻¹⁶	21.93	1.667 × 10 ⁴	1	164.5
1 m ² kN ⁻¹ s ⁻¹ =	8314 Т	8.314 Т	8.314 × 10 ⁻³ T	1.38 × 10 ⁻²⁰ T	0.1333	101.325	6.079 × 10 ⁻³	1

To convert a rate constant from one set of units $\frac{A}{2}$ to a new set $\frac{B}{2}$ find the conversion factor for the row $\frac{A}{2}$ under Column $\frac{B}{2}$ and multiply the old value by it, e.g. to convert cm molecule $^{-1}s^{-1}$ to m mol $^{-1}s^{-1}$ multiply by 6.023 x $^{-1}10^{-1}$.

Table adapted from Evaluated Kinetic Data for High Temperature Reactions, Volume 1: Homogeneous Gas Phase Reactions of the $^{\mathrm{H}_2}$ - $^{\mathrm{0}}_2$ System, Butterworths, London, 1972.

EQUIVALENT THERD ORDER RATE CONSTANTS

4 _{kN} -2 _s -1	1.447 × 10 ⁻⁸ T ⁻²	1.447 × 10 ⁻² T ⁻²	1.447 × 10 ⁴ T ⁻²	5.248 x 10 ³⁹ T ⁻ 2	56.25	9.74 x 10 ⁻⁵	1.623 × 10 ⁶	1
ppm ⁻² min	1.003 × 10-19	1.003 × 10 ⁻¹³	1.003 × 10 ⁻⁷	3.64 × 10 ²⁸	3.46 × 10 ⁻⁵	6 × 10 ⁻¹¹	1	6.16 × 10 ⁻⁷
atm -2 -1	1.48 x 10 ⁻⁴ T ⁻²	148 T ⁻²	1.48 x 10 ⁸ r ⁻²	5.388 x 10 ⁴³ T ⁻²	5.776 × 10 ⁵		1.667 × 10 ¹⁰	1.027 × 10 ⁴
(mm Hg) -2 -1	2.57 × 10 ⁻¹⁰ T ⁻²	2.57 × 10 ⁻⁴ T ⁻²	257 T ⁻²	9.328 × 10 ³⁷ T ⁻ 2	. 1	1.73 × 10 ⁻⁶	2.89 × 10 ⁴	0.0178
cm molecule -2 -1	2.76 × 10 ⁻⁴⁸	2.76 × 10 ⁻⁴²	2.76 × 10 ⁻³⁶	1	1.07 × 10 ⁻³⁸ T	1.86 × 10 ⁻⁴⁴ T ²	2.75 × 10 ⁻²⁹	1.904 × 10 ⁻⁴⁰ r ²
6 m mol - 2 -1	10-12	10-6	1	3.628 × 10 ³⁵	3.89 × 10 ⁻³ T ²	6.733 × 10 ⁻⁹ 1 ²	9.97 × 10 ⁶	6.91 × 10 ⁻⁵ T ²
dm mol -2 -1	10-6	1	106	3.628 * 10 ⁴¹	3.89 × 10 ³ r ²	6.733 * 10 ⁻³ T ²	9.97 × 10 ¹²	69.1 T ²
cm mo1-2-1	1	106	1012	3.628 × 10 ⁴⁷	3.89 × 10 ⁹ T ²	6.733 × 10 ³ T ²	9.97 × 10 ¹⁸	6.91 × 10 ⁷ T ²
A B	1 cm mol-2-1 =	1 dm mol-2-1 =	1 m mol -2 -1 =	1 cm molecule 2 -1 =	1 (mm Hg) ⁻² s ⁻¹ =	l atm ⁻² s ⁻¹ =	<pre>l ppm -2 min -1 = at 298K, l atm. total pressure</pre>	$1 \text{ m}^4 \text{kN}^{-2} \text{ s}^{-1} =$

See note to Table for Second Order Rate Constants

FION COEFFICIENTS	 .	dm 3mol 1 cm 1 base 10 cm 2 mol 1 base 10	10.6 10.4	24.4 2.44 × 10 ⁴	1.86×10^4 1.86×10^7	9.73 9.73×10^3	22.4 2.24×10^4	1 10 ³	10-3	2.62×10^{20} 2.62×10^{23}
CONVERSION FACTORS FOR UNITS OF OPTICAL ABSORPTION COEFFICIENTS	$(atm \ at \ 273)^{-1}cm^{-1}$		1.09	2.51	1.91 × 10 ³	1	2,303	0.103	1.03 × 10 ⁻⁴	2.69 x 10 ¹⁹
ONVERSION FACTORS FOR I	(cross section 0)	cm molecule base e	4.06 × 10 ⁻²⁰	9.35 x 10 ⁻²⁰	7.11 × 10 ⁻¹⁷	3.72 × 10 ⁻²⁰	8.57 × 10 ⁻²⁰	3.82 × 10 ⁻²¹	3.82 × 10 ⁻²⁴	1
Ö	В	A A	1 (atm at 298) ⁻¹ cm ⁻¹ base e=	1 (atm at 298) ⁻¹ cm ⁻¹ base 10=	1 (mm Hg at 298) -1 cm -1 base 10 =	1 (atm at 273)-1cm-1 base e=	1 (atm at 273) ⁻¹ cm ⁻¹ base 10=	1 dm ³ mol ⁻¹ cm ⁻¹ base 10=	1 cm ² mol ⁻¹ base 10 =	1 cm ² molecule ⁻¹ base e =

To convert an absorption coefficient from one set of units \underline{A} to a new set \underline{B} , multiply by the value tabulated for row \underline{A} under column \underline{B} , e.g. to convert the value of the absorption coefficient expressed in $dm^3 mol^{-1}cm^{-1}$ base 10 to (atm at 273) $^{-1}cm^{-1}$ base e, multiply by 0.103.

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